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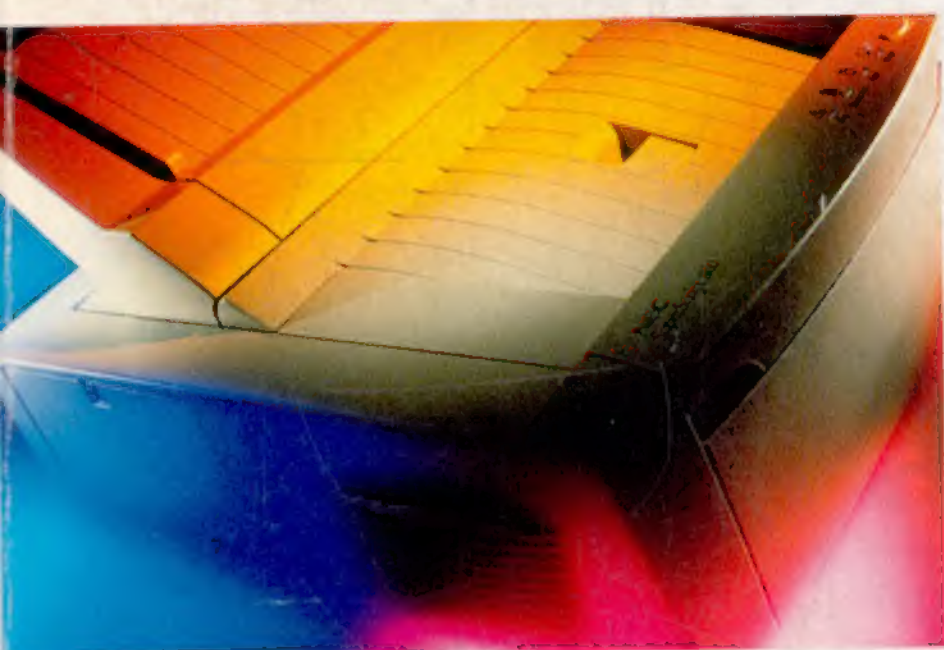
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MAGAZINE



**PC LABS
TESTS 37**

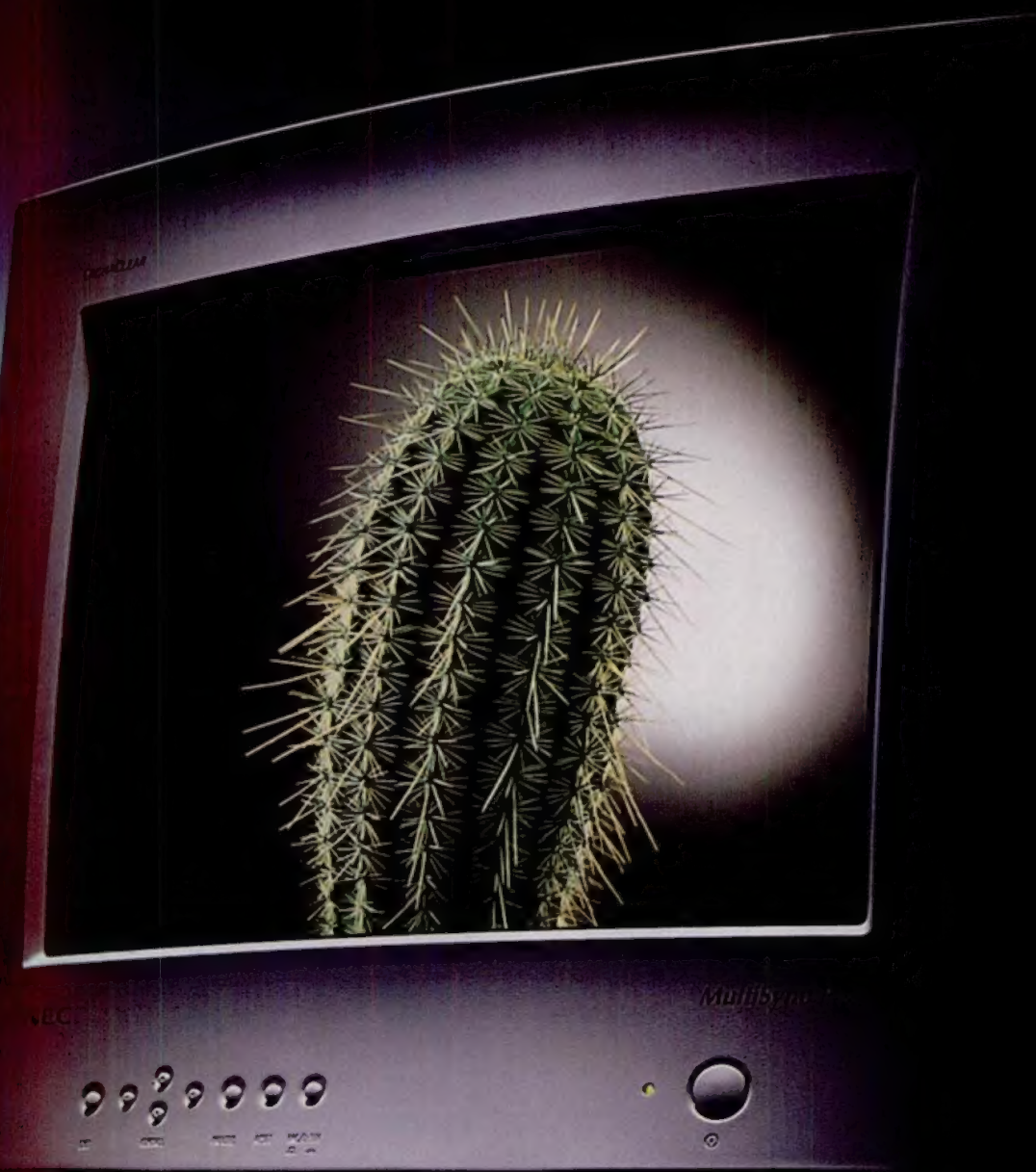


PRINTERS



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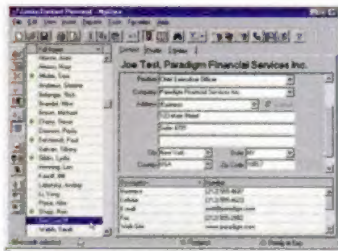
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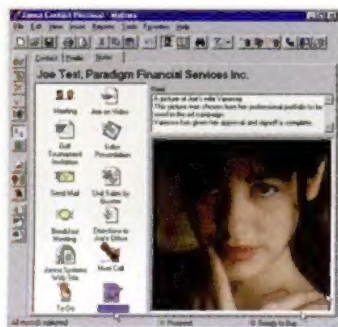
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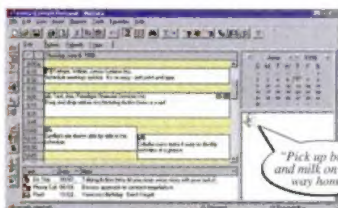
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CIRCLE 383 ON READER SERVICE CARD

Inside

With dozens of printers of all sizes and prices crowding PC Magazine Labs for our annual roundup, one member of the project referred to the Labs space as “printer heaven.” You’d have to like printers a lot to think of these three months of testing,

analysis, and writing as heavenly, but then, we found a lot to like in this newest generation of printers.

In a break from *PC Magazine* tradition, we’re presenting the results of our annual printer tests in two issues, following the clear split

and-white documents as well as stunning color output—all for hard-to-believe low prices.

Even more exciting than the plummeting prices of all personal printers were our findings that the cost of operating ink jets has fallen dramatically in the last year, making it easy to see why ink jets are outselling laser printers six to one. Our test results suggest that this trend will continue, particularly with the new crop of four-color ink jets.

Once again, our hardware team spent the summer immersed in our annual printer extravaganza. Associate editor Jamie Bsates and associate project leader Laura Cox saw the personal printer reviews through to completion, with the assistance of editorial researcher Jeremy Olshan and the guidance of project leader Jeff Mace, technical director Nick Stam, and executive editor Bill Howard. Support technicians Richard Brown, Christian Martin, and Jacqueline Paredes provided the many hands that made light work of this massive project.

Now that the project is complete and the team has come back down to earth, we’re already beginning the process of scouting out the technologies that will be the soul of next year’s roundup. —*Jake Kirchner*



Jeremy Olshan (left), Laura Cox, and Jamie Bsates in printer heaven.

of the market into business and personal devices. In this issue, we focus on personal printers, following on the heels of our comparison of business color printers in our previous issue.

The personal printer market continues to be a face-off between ink jets and lasers. The advantage seems to be falling to the ink jets, whose latest technology gives home and small-office users the ability to produce excellent black-

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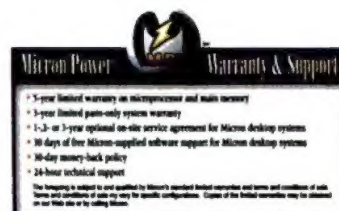
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Personal Printers Showdown

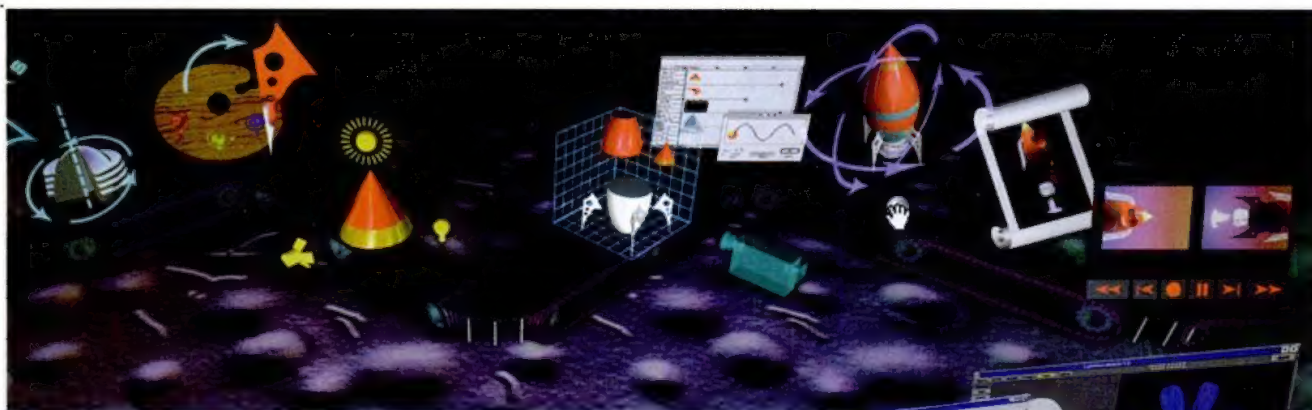


BY ALFRED POOR Ink jet and laser

printers are gunning for one another with better print quality and lower prices. Laser printers, which can be had for as little as \$300, still produce the crispest, cleanest monochrome output for business documents. But a \$300 ink jet can produce text that approaches laser quality and give you the versatility of good—and sometimes outstanding—color output for your office or home needs. We test 13 ink jets, 17 lasers, and 5 of the best multifunction printers for speed and output quality; check our output samples to see what these printers can do. Also turn to the results of our annual Service and Reliability survey to find out how our readers rate the top printer vendors100

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FEATURES



3-D Animation Software

Ideas Taking Shape



BY LORI GRUNIN If you've ever wanted to add depth and breadth to your object creations to make them come to life—at least on your PC screen—now you can do so without breaking your budget or using a high-end graphics workstation. For the first time ever, we review eight 3-D software animation products—some under \$500 and all running on a PC—that let you model, render, and animate to your heart's content. In a series of sidebars, we look at other products specifically designed to build 3-D type and logos, add special diffuse lighting effects, or integrate 3-D with CAD packages. We also provide a glossary that gives you the essentials of 3-D terminology190

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Virtual Reality Modeling Language

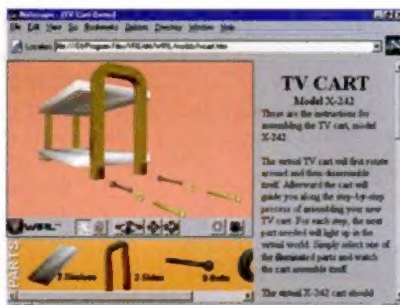
The Web Goes 3-D

BY LINDA AND ERICK VON SCHWEBER Virtual Reality Modeling Language (VRML) opens up the exciting possibilities of the third dimension on the Web. The latest VRML authoring tools let you build rich 3-D worlds, often modeled after the real 3-D space we live in. We review five world builders that will set the tone for future VRML development in this quickly evolving market. Our tests of [11 VRML browsers show end users where to begin their 3-D journeys](#), navigating and exploring the worlds already on the Web. We also reveal which browsers developers can trust to do justice to the worlds they've built.229



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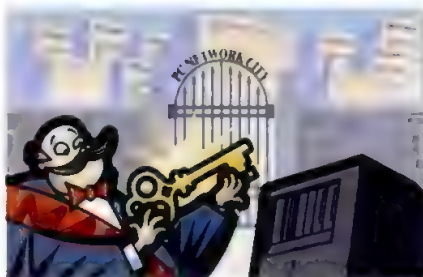
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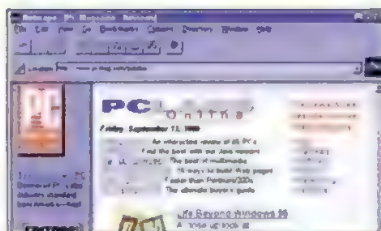
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WHAT'S NEW ONLINE

Visit PC Labs Online (www.pcmag.com/plabs) and discover interactive versions of this edition's stories. Check out ink jet versus laser printers, then find out how you can enter the third dimension using 3-D animation software or VRML builders. And while you're at PC Magazine Online, take a look at our Editors' Choice Gallery and see all of the winners from September 1995 to the present.

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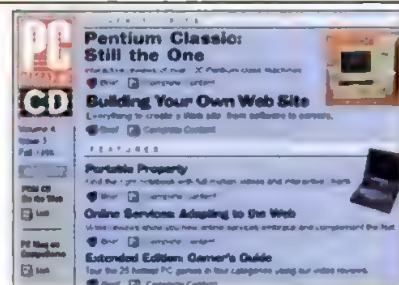
Gamer's Guide

Video reviews of the 25 hottest PC games in four categories.

Utilities and software: MultiLaunch associates more than one application with a file extension, Hotkey Detective lists hotkeys in use, InCtrl 3 lets you track system changes, RUPL adds programs to your Windows 95 Start menu, and Quod tests your gaming strategy.

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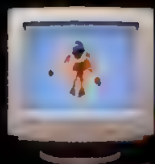
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Windows Sources, July 1996

"When it comes to seriously engineered CD-ROM drives, no one does it better or more consistently than Plextor."
New Media, February 1996

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Best Buy: PC World, Sept 1996

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CIRCLE 196 ON READER SERVICE CARD

Letters

SEARCHING FOR THE IDEAL

The July 1996 cover story, "The Perfect PC," was both informative and timely. It helped me decide on several of the components to select in my next system. I would have liked to see a discussion on the various modem speeds, when and why you would select an ISDN modem, and the V.34 standard, but overall thanks for making something as confusing as choosing options on a new PC a little more manageable.

C.J. SIMMONS
Indianapolis, Indiana

I found the "Perfect PC" discussion interesting. I noticed, however, that you didn't mention serial ports or the recommended number of slots. I just upgraded my new SDRAM-equipped Dell Dimension system. I like its speed, cleaner cabling, and reduced fan noise but was disappointed by the reduced peripheral and internal expansion potential.

JEFF DEL PARA
via the Internet

Thanks for all the good information in your cover story. However, I couldn't find any discussion of memory parity checking in any of the articles. I've long had the opinion that parity checking is one of the most important features of a CPU/motherboard combination. It seems that many of today's Pentium motherboards, including those using the Intel Triton chip set, do not have parity checking. While nonparity memory is a little cheaper, I'm wondering if this is a serious deficiency in the design of these motherboards.

KEN YAVIT
via PC Magazine

Your series of "Perfect PC" articles was right on target. The information was timely, informative, concise, and well written. Those of us who are about to invest in new equipment for our small businesses are truly in your debt. It is very difficult to plan for future equipment needs with the constant barrage of newer, faster, and better options coming from vendor after vendor.

VICTOR L. BOYETT
San Marcos, Texas

Kudos are in order for your "Perfect PC" cover story. As a diehard OS/2 user and occasional Windows 95 user, I appreciate that there was no underlying prejudice toward one operating system over another.

ANDREW COHEN
Tuscaloosa, Alabama

When I first saw the "Perfect PC" issue, I expected it to be the usual comparison of pre-bundled PCs from the big names like Com-



Your articles were right on target for those investing in new equipment for small businesses.

paq. I was therefore surprised and genuinely impressed to find excellent coverage of the different components of today's and tomorrow's PCs. You weren't afraid to get a little technical, which really made it worth reading.

RICK BYERS
Welland, Ontario, Canada

PCs still cost obscene amounts of money; they are still too big and heavy, too slow, too often subject to crashing; and they do not interconnect well with each other. Do me a favor: Call me when the first pocket-size, instant-on, wireless computer/organizer/communicator/remote control with a Teraflop of computational power and a truly universal operating system hits the stores. In the meantime, your reviews should be called "PC Magazine's Really Good PCs, All Things Considered."

STEVE JORDAN
via the Internet

Last year I wrote to compliment you on your best issue ever. This year I'm writing to compliment you on the best issue ever by far. The technical information was far superior to anything else available, and the presentation was outstanding.

WARREN E. LARSON
Shadow Hills, California

MORE INPUT, PLEASE

Your "Perfect PC" issue had a short section called "The Perfect Memory." I would have appreciated a more in-depth discussion of the new 16MB chips and which PC manufacturers are including these chips in their systems. I was also curious to learn more about the

64MB chips and when they will start showing up in high-end PCs.

MIKE MIHELICH
Coeur d'Alene, Idaho

I HAVE A DREAM

I looked forward to this year's "Perfect PC" issue with great anticipation. What I found was disappointing. The research and knowledge that distinguished last year's issue was lacking in this year's, most evidently on the subject of removable media, a topic included for the first time. Besides the touting of vaporware, I found it implausible that the 120MB floppy disk drive should be included in the "dream system." A much better choice would have been the larger-capacity, faster Iomega Jaz Drive.

PATRICK KEELER
via the Internet

PC Magazine's "Dream System" recommends a tape drive for backup. How passé! Those of us who suffered from broken-tape syndrome have long ago upgraded to removable media for backups. It doesn't take very many eaten tapes to see that almost anything is an improvement.

ROBERT P. SEELEY
via the Internet

CANNOT COMPUTE

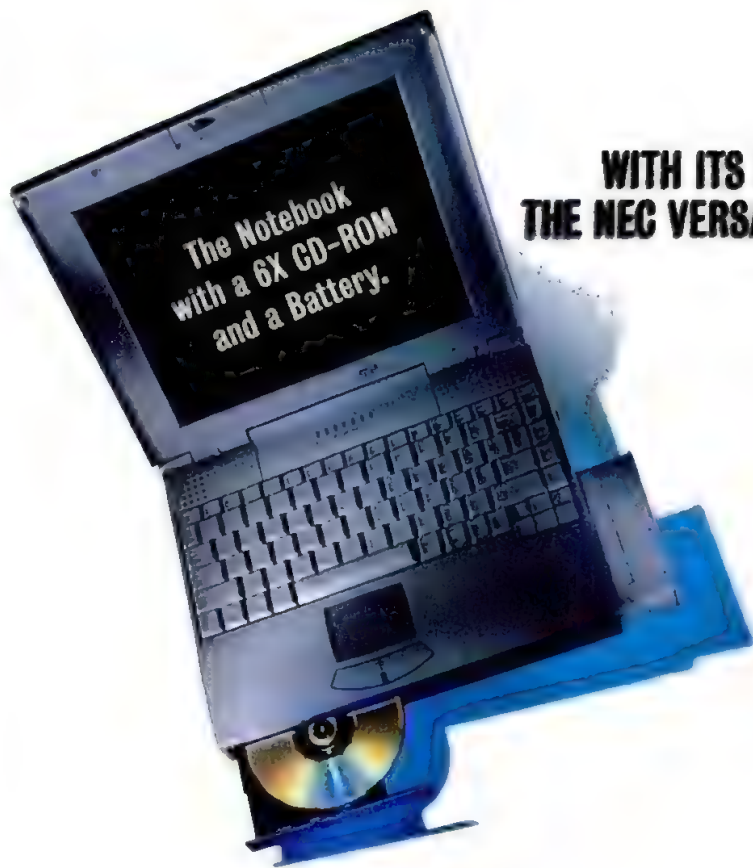
Your article "The Perfect Processor" is misleading because there's no mention of the fact that you can't simply remove an Intel Pentium processor and replace it with any of the alternatives mentioned in an effort to improve system performance. Some may allow you this flexibility, but you fail to identify which processor and motherboards do.

JIM STUART
via the Internet

I noticed a contradiction in your "Perfect PC" issue that I was curious about. In the table entitled "If Your Perfect Operating System Is..." (page 103), you state that the best processor for Windows 95 and OS/2 Warp Connect is the Pentium/200 and the best for Windows NT is the 200-MHz Pentium Pro. However, in the section "The Perfect Processor," a contradictory sentence appears, stating that "the Pentium Pro performs at its best with a full 32-bit OS, such as Windows NT or OS/2 Warp, not Windows 95." So which is it?

STEVE BEVACQUA
via the Internet

Our testing shows that both OS/2 Warp and Windows NT are well suited to Pentium Pro systems equipped with at least 32MB of RAM. OS/2 Warp is also well suited to typical 16MB Pentium systems.—Ed.



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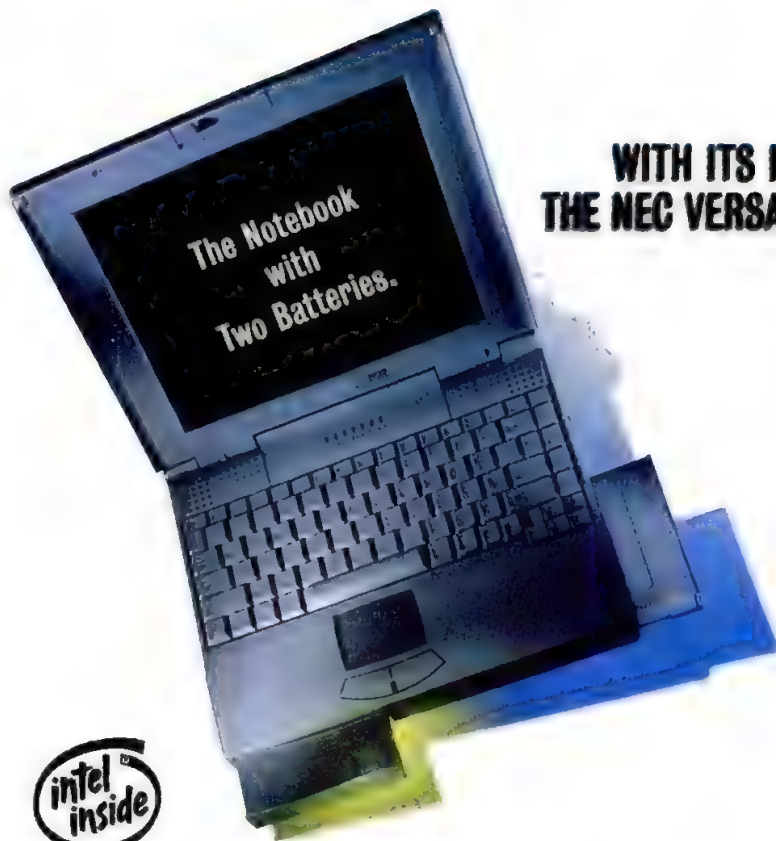
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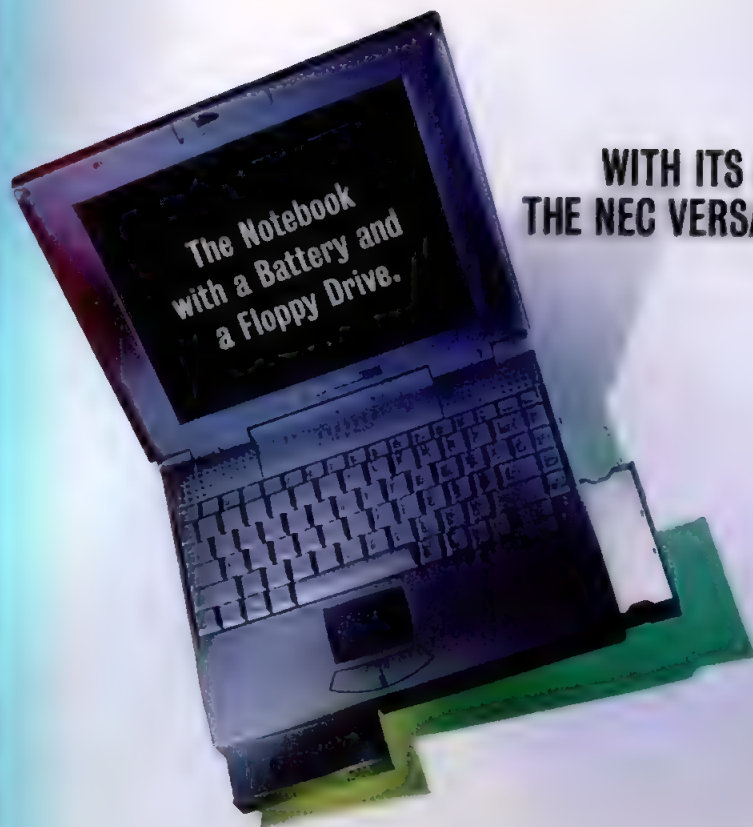
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Letters

GETTING GOOD HELP

What use is technical support if you cannot access it when you need it? Many of your significantly better-than-average companies answer their phones only from 8:00 A.M. to 6:00 P.M. on weekdays. And even when you do call at the right time, it is a toll call and you can end up on hold for up to an hour. To add insult to injury, many are now charging fees. In your next survey, please consider including the average wait time to talk to a real person as well as the average expense (toll call and other fees) it takes to fix problems.

HOWARD S. LAU
via the Internet

SITTING PRETTY

You might consider adding another question to your software Service and Support story: What shelfware do you own? That is, software you have bought, used, and given up on for any number of reasons. I once asked this question of a PC user group; the answers and explanations revealed trends and dead ends before they became evident elsewhere in the market.

JIM CHESKY
Portland, Oregon

PERSONAL EXPERIENCES

I was disturbed to read that Toshiba received a grade of A among notebook vendors for Service and Reliability (July 1996), since my own experience with Toshiba was so diametrically opposite. Toshiba has not supported the T4900 CT laptop computer I purchased in 1995 and seems utterly unconcerned that although the unit was purchased new and sports

HOW TO CONTACT US--

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CORRECTIONS AND AMPLIFICATIONS

In the August 1996 issue, the sidebar entitled "Remote Control for OS/2" on page 236 incorrectly stated that Remote Services Management (RSM) is sold in the U.S. by Software Corp. of America. International Software Solutions, the developer of RSM, sells the product directly from an office in West Palm Beach, Florida (407-820-0802; www.iss2you.com).

In our September 10, 1996, review of IBM Corp.'s Internet Connection Secure Server for OS/2 Warp (page 180), the list price was stated incorrectly. The correct list price is \$295.

a three-year warranty, it has not been functioning for the last four months.

IAN BLAIR FRIES
Brick, New Jersey

I am surprised at Compaq's getting the top spots for Service and Reliability in your survey. I am a very disappointed Presario user.

HENDRY MICHAEL
via the Internet

In your recent article "Readers Rate Service & Reliability," ALR received a grade of D. My company has owned and used four ALR computers since 1990: three Business Veisas and one Evolution V ST/90. Not one of these machines has ever missed a day. On the rare occasions when I called ALR's technical support, I never waited more than 30 seconds for help, and I always received the correct information to my query. Consequently, I don't understand your negative rating.

STUART TOBIN
via the Internet

SHOOTING FOR THE STARS

A grade of D from PC Magazine on Service and Reliability for Texas Instruments' notebook computers (July 1996) is unacceptable to TI's Personal Productivity Products Group. TI has long been known as a technical innovator and quality manufacturer in the computer industry; however, customer satisfaction is the most important measure of success in our business. The below-average grade correlates with the findings of our own customer-satisfaction survey.

In our study, TI notebooks ranked higher than those of all leading competitors in important factors including battery life, weight, processing speed, clarity of screen, pointing device, and keyboard layout. But as you pointed out, service and reliability needed improvement. The chief reason for our below-average performance in service and reliability was that we experienced intermittent problems with early models of the Travel-Mate and Extensa lines. PC Magazine does a service by publishing an annual survey on service and reliability. We are confident that our recent D grade will be an A in the next such survey.

PALLAB CHATTARJEE, PRESIDENT
Personal Productivity Products,
Texas Instruments,
Dallas, Texas

For further information, go to Texas Instruments' Web site (www.ti.com) to retrieve a white paper.—Ed.

DIFFERENT FOLKS, DIFFERENT STROKES

Concerning Jake Kirchner's July 1996 Pipeline column, "I'm Just Glad Somebody Wants My Business": No single business entity is going to be able to satisfy all its customers. If MCI Mail is happy with fewer customers and can survive well that way, why not be happy for MCI, too? After all, you were able to walk away and get what you were looking for right around the corner. By the way, there's definitely nothing innovative these days about a service supported solely by advertising.

TONY JULIO WONG
Nassau, Bahamas

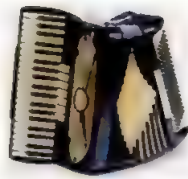
FACTS AND FIGURES

We question PC Magazine's editorial decision to weigh performance so heavily in selecting the Editors' Choice recipients for intranet Web servers in the September 10, 1996 issue. We maintain that there were two principal flaws in the testing and reporting methodology: First, the stress loads were increased far beyond the typical usage for the vast majority of sites; second, the performance tests highlighted document caching, a feature found only in some servers, and one that does not materially affect server operation under normal loads.

The positive comments made by the reviewer about WebSite Professional's ease of use are partly a result of our doing things in the runtime module that are not done by other servers. These tradeoffs in designing WebSite may affect its performance, but the impact is not noticeable unless you plan to serve millions of hits per day.

ROBERT B. DENNY
Lead Developer, WebSite Server
O'Reilly & Associates Inc.

Performance is only one of many criteria that we consider in selecting Editors' Choices. We explain in several places in the Web Server story that our performance tests pushed these servers beyond what is required in the real world today, and that all the servers tested performed sufficiently well to handle regular business traffic. We feel that document caching is an important feature in a well-behaved intranet server.—Ed.



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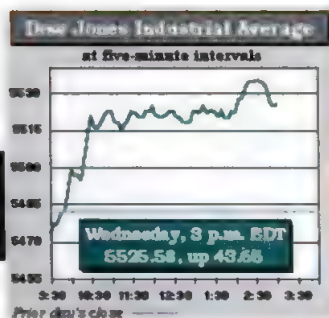
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The Browser Skirmish

Lately, the big topic in the world of the Internet has been the Browser War. We've all gotten involved in the discussion of which browser will win: Netscape Navigator or Microsoft Internet Explorer. It's an interesting question, because browsers are the way

we, as end users, connect to the Internet, and they determine how that world looks to us. It's also interesting because the battle pits an upstart that basically established the market against a giant that got Internet religion late.

But in some ways, the whole battle about which browser you use masks the real war going on among Netscape, Microsoft, and others. The competitors know that the real money isn't made selling clients to end users—at least not for the foreseeable future. Instead, the goal for these companies is to sell software to other companies for use on intranets. That's why companies like Netscape and Microsoft constantly talk about intranets, organize intranet strategy days, and spend enormous amounts of time talking about why developers should adopt their platforms.

The real action is in selling the servers, application environments, programming tools, and applications to corporations. The applications include messaging, communications, collaboration, scheduling, directory services, and database programs.

In the next few years, the Internet, along with other technological developments, will force medium and large organizations to rethink the way they handle these applications.

Clearly, Netscape sees Microsoft as the big threat here, and the company is focusing on its distinguishing features. In particular, Netscape is pushing its reliance on "open" standards—even while it repeatedly attempts to forge new standards and extend existing ones. Netscape talks a lot about how Navigator supports multiple platforms and multiple databases. And it stresses interoperability.

Microsoft sees its strength as the integration of many different technologies, from desktop applications to the Windows NT platform to the suite of BackOffice components. Microsoft's strategy is to build on Internet standards, the continuing advances in microprocessors, and the WinNT platform as a way to take on more and more computing tasks in large organizations—especially the tasks now performed on workstations, minicomputers, and mainframes. It's a potentially huge market. The company promises to support other platforms, but few doubt that Micro-



THE FRONT LINE
The whole battle about which browser you use masks the real war taking place.

soft really prays at the altar of Windows.

Of course, there will be a lot of other players in the networked-applications space. Lotus Notes is already entrenched in the fight for messaging and collaboration, and its parent IBM is a big player for larger corporate applications like transaction management. Novell's Groupwise is a strong contender in the messaging arena, and its Intranetware merges the company's established file and print services and growing directory services with a suite of intranet tools.

Oracle wants a piece of this evolving market as well, not only for its databases but for other applications built on top of them and the services they provide. It's why Oracle is pushing the idea of the network computer. And don't forget database vendors, such as Informix and Sybase, or companies like Computer Associates, which specializes in these kinds of apps. Even Sun, a Netscape ally, wants to compete in this space with its hardware and software (most notably Java).

All of this sets the stage for another battle that's brewing: the competition to

create content and information sites for end users—the equivalent of broadcast channels. But there will be many players in this market, so while some software companies (including Microsoft and AOL) try to create their own content, others will sell their applications and tools to other content creators. At first, the big money isn't in tools for end users; it's in the content and in the server-side applications and tools.

If the battle to create corporate applications is the long-term prize, why are companies like Netscape and Microsoft so focused on browsers? One reason is that browsers determine the look and feel of these back-end applications. Also, having a lot of browsers installed provides a company—Netscape, in particular—with an entry point into large organizations. Yet another reason is that by controlling a large share of the browser or network-client market, you get to set or at least influence the standards—a critical time-to-market advantage.

So in a way, the browser battle is important. But make no mistake: It only foreshadows the larger battles that are just beginning to emerge. □

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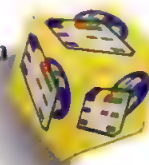
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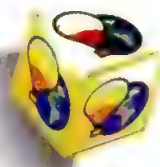
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Trends

TRENDS & TECHNOLOGIES SHAPING THE PERSONAL COMPUTER MARKET

Web Photo Finish

New online services for shutterbugs.

Picture this: You shoot a roll of film with your camera, drop off the film at your neighborhood drugstore, and retrieve the photos the next day—from the Web. You then touch up the photos on your computer, fill out an electronic order for a poster-size image of the family dog, and e-mail some of the summer vacation shots to Grandma.

The recent Seybold desktop publishing conference held in San Francisco was a showcase for a slew of new technologies for Web users who want to send, download, and print high-resolution photos. From big companies, such as Microsoft, Kodak, and Hewlett-Packard, to smaller

players, such as Live Picture and Picture Vision, there's a renaissance in PC-based photo imaging, with new services and new software at low prices. And with 700 million rolls of film processed each year—representing retail sales of over \$45 billion—the business opportunities are potentially enormous.

Microsoft's Picture It software is an under-\$80 package for home PC users who want

to scan, edit, print, and share photos over the Web. Picture It will feature a link to a Web page containing a catalog of photo-development choices that Microsoft developed in conjunction with Kodak's digital photography division.

You'll be able to take photos you've edited in Picture It and send them over the Web to Kodak after choosing from a palette of sizes, resolutions, and other format options. Kodak will either mail you prints of the photos or send them to you over the Web. Picture It will support the new FlashPix graphics format, which stores an image as a hierarchy of versions at different resolutions, making large images easier to edit, transmit, and print. For example, you can send a photograph shot at low resolution over the Internet to a friend, who can download, edit, and print the image at a higher resolution.

LivePix, a similar package from Live Picture—which is



headed by former Apple chief John Sculley—and Hewlett-Packard also supports the FlashPix file format.

A special offer included with LivePix invites you to send a roll of film to Kodak Digital Processing and receive a free Kodak Picture Disk, a floppy disk that holds up to 28 digitized images. MGI Software's PhotoSuite, a popular PC photography package, also includes the Kodak offer. Picture It, LivePix, and PhotoSuite compete directly with Adobe's

\$89 PhotoDeluxe software. Kodak expects the product category to drive a big rise in its digital photo business.

Newcomer Picture Vision, of Sterling, Virginia, goes a step further. It will convert film into digital images for you and upload them to PhotoNet, the company's network of Online PhotoCenters. Picture Vision has struck deals with over 1,000 photo retailers and wholesalers—including Kits Cameras, Konica, and Ritz Camera—so you can drop off your film as usual and view the images on the Web the next day.

PhotoNet sends you a password via e-mail, so that only you and those you choose can view proof sheets, touch up photos, and order reprints, enlargements, and such merchandise as T-shirts and mugs. PhotoNet also serves as a Web warehouse: You can store photos for 30 days (or, for a fee, for longer) on PhotoNet. The service costs from \$6 to \$10 per roll of film.

By joining up with photo retailers, PhotoNet doesn't cut them out of the loop as the industry moves to digital cameras; instead, PhotoNet serves as a bridge between film and digital photography. PhotoNet recently struck promotional deals with Adobe, American Greetings, and Netscape.

Web-based photo service is still a fledgling market, but some industry players say that within the year there could be some big improvements, especially in speeding up the analog-to-digital conversion process. And once digital photo kiosks are manufactured in greater quantity—and prices of digital cameras come down—you'll be able to pop a PC Card into a kiosk and get photos in a flash.—Sebastian Rupley and Carol Levin



3 Link to Kodak's photo-finishing Web catalog. Select poster-size and photo mug. Transmit the image.

2 Transfer the photo from the PC Card to your PC. Edit the image with Microsoft's Picture It.

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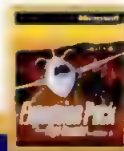
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Web Tax Shuffle

Cyberspace is a sales tax haven.

Quick—answer this question: If you live in California and you order a music CD on the Web from a music merchant located in Maine, do you owe sales tax to the state of California on the purchase?

The answer is a definite yes, but it's another question entirely whether you'll actually pay that tax. In fact, it's currently very unlikely that you ever will.

The application of current tax laws in many states is murky when it comes to electronic transactions. Federal law dictates that an electronic purchase from an out-of-state vendor may be taxed by the buyer's state, but the merchant selling the product has no responsibility to collect the taxes or even to report the transaction. The law works similarly for mail-order purchases, and states lose a sizable amount in tax dollars because of the difficulty of policing mail-order transactions.

According to Kaye Caldwell, chair of CommerceNet's Public Policy Special Interest Group, California alone gave up about \$180 million in tax revenue last year due to the lack of a coherent method of tracking mail-order purchases. As the number of electronic transactions rise, even more sizable tax losses are expected to take place. Efforts are under way to head off the problem, which could have a significant impact on the growth of electronic commerce.

Caldwell says that a few states, including Maine and Tennessee, already include a line on their income tax returns for people to report out-of-state purchases. "An approach where such a requirement appears on a tax return—with a default tax being required unless actual purchases are tallied—is at least a step in the right direction," Caldwell adds.

Dollars from Cyberspace

Advertising is big business on the Web.

Web-based advertising revenue increased 83 percent within the second quarter and is well on its way to reaching \$312 million by the end of the year and \$5 billion a year by the year 2000, according to a study by Jupiter Communications, a New York City-based market-research firm.

Ad revenue from the Web makes up only a small portion of the total dollars spent on advertising in all media—including TV, radio, and print—but it's expanding fast, says Jupiter Communications senior analyst Peter Storck.

Since the beginning of this year, about 600 Web sites have taken home \$71.7 million in ad revenue, with ten Web sites grabbing 66 percent of that figure. Netscape

led the pack with over \$9 million, followed by four of the five most popular search sites—InfoSeek, Yahoo!, Lycos, and Excite—with earnings between \$3.6 and \$5.7 million. WebCrawler earned over \$2 million in the first half of the year, and technology-oriented sites cnet and ZD Net (owned by Ziff-Davis Publishing, *PC Magazine's* parent company) each earned over \$3 million.

The survey also revealed that the companies that earn the most ad dollars are likely to spend the most on advertising. InfoSeek, Excite, and Yahoo! all took top spots, spending between \$1.2 and \$2.9 million

to place ad banners on other sites. The most notable exception to this trend is Microsoft, which in the first half of the year spent more—about \$2.9 million—on advertising than any other site but didn't earn enough in ad revenue from its own site to make Jupiter's top-ten list.

Jupiter also tracks surfers' atti-

tudes toward advertisements on the Web. According to another report, users are becoming used to ad banners on Web sites and, in many cases, consider them integral to their online experience. The report also showed that users are more likely to click on an ad that displays a recognizable logo or brand name.

Though not all advertising is used to sell products, the sites that do are probably benefiting from their advertising efforts, according to Jupiter. The search sites, which promote Internet traffic rather than sell products, are encouraging Internet transactions as well, but at this point, no one has put a number on just how many transactions result from Web advertising.

—Angela Hickman

Top CD-ROMs

- 1 **Microsoft Windows 95 Upgrade** Microsoft
- 2 **Warcraft II: Tides of Darkness** Blizzard
- 3 **Duke Nukem 3D** 3D Realms Entertainment
- 4 **Corel WordPerfect Suite Upgrade** Corel
- 5 **Print Shop Deluxe CD Ensemble** Broderbund
- 6 **Myst** Broderbund
- 7 **Civilization II** MicroProse
- 8 **Microsoft Plus! for Windows 95** Microsoft
- 9 **Print House for Windows 95** Corel
- 10 **Toy Story Animated StoryBook** Disney

*Source: PC Data. Data for August 1996.

Constitutionally, states can't force an out-of-state seller to levy a tax on purchases directly. But several states have suggested that all mail-order and electronic purchases should be reported from merchants to the state. Critics of this approach argue that it constitutes an invasion of privacy, since the Web and mail-order are avenues for many of the purchases buyers would like to keep private.

CommerceNet has suggested reevaluations of tax structures for electronic purchases. America Online, CompuServe, and Microsoft are also working on the issue. Microsoft, with Ernst & Young, is producing a white paper of ideas for solutions. The Redmond software giant is aiming to become a big player in electronic commerce, the growth of which will be affected by whatever solution to the tax problem comes about.

But there's no main answer in sight, and few buyers even realize that they owe taxes on Internet transactions conducted with out-of-state vendors.—*Sebastian Rupley*



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Banks Team Up for Online Venture

IBM leads banking industry into private network.

IBM and a consortium of banks plan to give 60 million households their first tangible reason to use the Internet. In a move to retake what they consider to be their rightful control of electronic financial transactions, 15 North American banks, along with IBM, have formed a new company called Integrion that's in the throes of developing a giant private network—linked to the Internet—connecting banks, merchants, and customers.

"With this new venture, electronic commerce will take its biggest step forward to date. A secure networked marketplace is essential to the growth of electronic business," says IBM CEO Louis Gerstner.

A few years back, the banking industry became skittish when

software developers—notably, Intuit and Microsoft—started encroaching on its turf. Considered a dinosaur of the digital age, the banking industry needed some radical changes.

By sharing the infrastructure for online financial services, the founding banks—including Bank of America, Mellon Bank, and the Royal Bank of Canada (along with any other bank that wants to join)—can take advantage of economies of scale, thereby reducing the cost of developing online services. The network will support bill payment, portfolio management, Internet access, electronic commerce, and customer service.

The Internet is "hardly a network in which you can perform secure financial transactions,"



Gerstner says. Integrion is building the middleware, which will include security features, and the individual banks are building the software the customers will see.

Integrion expects to publish an open set of standards for transferring funds and conducting secure transactions, so that any develop-

er can write software and sell it to Integrion or to the banks. The open architecture means you'll be able to use the personal finance manager, browser, or online service of your choice. "It would be our hope," Gerstner says, "that Intuit would bring out a version of its financial planning software that's consistent with Integrion's standards."

Software that uses the Integrion network will work on a variety of hardware, from pagers to PCs. Banc One and NationsBank expect to have pilot applications ready by the first quarter of 1997.

Meanwhile, Intuit recently decided to sell Intuit Services Corp., its electronic bill payment division, to CheckFree, and is developing OpenExchange, an open standard for conducting banking over the Internet. Intuit is not positioning itself for a standards war but hopes to work with Integrion.—Carol Levin

Shirt-Pocket Computers

Microsoft's OS for the elusive hand-held market.

In spite of the many hurdles that have historically faced hand-held computing, Microsoft is making another go at it with a brand new operating system.

Windows CE is an open and scalable version of Windows designed to run stripped-down versions of desktop productivity applications, including an Internet browser. Casio, Hewlett-Packard, LG Electronics, NEC, and Philips expect to ship palmtop devices—priced around \$500—based on Windows CE starting in November. Hitachi, NEC, and Philips are producing the 32-bit RISC microprocessors. In addition to the hand-held market, Microsoft is positioning Windows CE for use in wallet PCs, digital information pagers, cellular smart phones, Internet phones, DVD players, Internet TVs, and set-top boxes.

Because Windows CE is designed to run smaller versions of desktop applications, much of its success rides on support from software developers. (Windows CE does include calendar and contact management applets.) The development environment supports an expandable subset of Win32 APIs, and according to Microsoft, over 30 applications developers support the platform, including Symantec, Puma, and RadioMail. Microsoft's PocketJava will be available as an add-on for developing and running Java applets.

Microsoft vice president Craig



PC Magazine Online Events



WWW.PCMAG.COM. Visit PC Magazine Labs Online to find interactive versions of this issue's stories on VRML, 3-D modeling, and personal printers. From October 28 to November 1, join us for discussions on 3-D animation software and TV tuner cards.

PC MAGNET. From this online service of ZD Net available through CompuServe (GO PCMAGNET), you can download utilities (GO TIPS) and join in discussions about new products (GO EDITOR). **First Looks Plus:** From October 21 to 25, discuss mapping technology with contributing editor Bruce Brown and industry representatives.—Tin Albano

Mundie says that Windows CE is targeted to "lower the hurdles for hardware manufacturers and software developers" who believe in hand-held computing. A paucity of useful applications, though, has been a problem for other hand-held computer offerings, such as Apple's Newton.

At a recent demonstration for PC Magazine at Microsoft's headquarters in Redmond, Washington, Mundie showed a prototype palmtop device running Windows CE. The device runs on two double-A batteries (supposedly for about 100 hours) and features an IrDA infrared transceiver for wireless synchronization of data with an infrared-enabled notebook or desktop.

Devices based on Windows CE will ship with Internet browsing capabilities; however, the screens are likely to be so small that browsing will be a tight squeeze. Several companies expect to show products in a variety of designs and sizes at the Comdex computer trade show this fall.—Sebastian Rupley

By Jake Kirchner

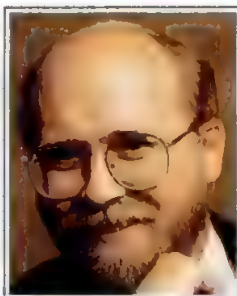
Converge Me, Please!

Nobody has been more intrigued than I by all the recent talk of "convergence"—the much bally-hoed melding of computing and entertainment technologies that has gotten a big boost with the appearance of several new PC technologies and trends.

Some would argue that the age of convergence has already arrived. After all, the average home PC has at least a modem, a CD-ROM player, and enough multimedia capability to play a wide range of electronic games. And many home PCs now have some telephony capability or photo-scanning devices. But this is all a mere toe in the convergence water, I say.

There's much more to be done. Fortunately, PC makers are getting some extremely interesting tools to work with these days, in the form of high-speed Pentiums with multimedia extensions, USB and FireWire bus architectures, low-cost large monitors, inexpensive memory chips, ISDN service, and third-generation Web browsers. These and other developments are powering a new generation of PCs. The Gateway 2000 Destination and the new Toshiba Infinia are just the first of the true multipurpose PCs we'll be seeing in the coming months. And not a moment too soon.

Looking around my home office, I took a quick inventory to measure my need for such devices. I found a desktop PC with a CD-ROM drive and an external backup storage device, a sound card attached to a stereo amplifier/receiver, a pair of stereo speakers, a hand-scanner, and a monochrome laser printer. On my desk is a telephone, an answering machine, a fax machine, a copier, an electronic paper-tape calculator, and a paper shredder. Elsewhere in the room are a 25-inch color TV, a VCR, a cable converter, a 32-bit video game



As we march into a new era, a modular approach to computing and electronic entertainment is key.

player, several joysticks, an intercom, a camcorder, a slide projector, a 35-mm camera, and a couple of clocks. Soon, I'll add one of those new color ink jet printers that print photographs and create T-shirts.

Converge me, please!

I would seem to be the perfect candidate for a machine like the Infinia, which "starts to define convergence," according to Tom Scott, general manager of the Computer Systems Division of Toshiba's U.S. subsidiary. This is one very nice PC. It elegantly combines a high-end Pentium desktop with a TV, a radio, and a telephone, plus provides high-quality sound and video.

But I have to ask myself what I really need: a PC that includes *some* of the devices and capability I already have, or an extremely powerful—and much less expensive—desktop that runs *most* of the devices for which I've already paid.

As we march into the era of convergence, we can expect to see an even greater variety of machines. Rather than having to choose from a few machines that serve all electronic computing and entertainment needs, we'll see many different combinations. Some people will want the TV tuner; others won't but will want the telephone answering capability. Others won't want either but will willingly pay for a photo-scanning keyboard and joystick. What you might not buy for yourself, you might buy for your spouse who runs a small business out of your home or for a child going off to college.

The modular approach allowed by these emerging technologies will be key to meeting the diverse market needs of convergence. Meanwhile, we'll see a lot of intriguing product choices. I just hope there's one that's right for me. I expect some will be colossal duds.

Home Videoconferencing

Reinventing the video phone.

Despite big marketing efforts by AT&T, video phones for the home never caught on. Now, companies such as Intel, Boca Research, and Lucent Technologies are betting that new standards and cheap processing power can make up for a phone line's limited bandwidth.

The advertisements for high-end PCs capable of video over plain old telephone service (POTS) will get started around the end of the year and get thick in early 1997. Intel, PictureTel, and Boca

Research are working hard to get receive-only video capabilities—based on chips made by Lucent—bundled into 166- and 200-MHz Pentiums. The PCs, shipped with receive-only video (two-way audio) capabilities, would need a camera and video capture card to transmit video, a \$200 to \$300 option.

The bandwidth of today's telephone lines limits the video quality of these POTS systems, but processing at each end can do a lot. High-end videoconferencing sys-

tems move images at 30 frames per second and handle large picture sizes. The International Telecommunications

Union's H.324 standard, which is poised to bring POTS video systems to new markets, calls for 4 to 12 frames per second, using small (176- by 132-pixel) frames. The video processing requires a minimum of a Pentium/133 at each end. (A Pentium/166 or 200-MHz Pentium Pro is preferable.)

Intel's multimedia extensions to the Pentium—known as MMX and expected in the first half of the year—will make video images smoother. Based on this minimum horsepower, the size of the video

image will be between that of a stamp and a playing card.

Meanwhile, Boca Research controls the retail market with its \$399 BocaPro Video Phone Elite. This PCI card has on-board video and audio processing, so it will work with any PCI-equipped PC.

Developers publicly talk about the "Hello, Grandma!" market, but the quiet-side bets are on technical-support and direct sales. Videoconferencing is also more likely to catch on in the consumer mass market this time around, because upcoming standards-based products will be interoperable. —Frank J. Derfler, Jr.



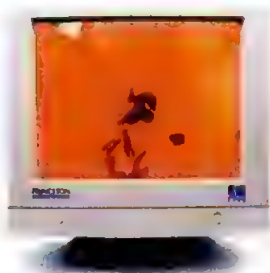
200 MEGAHERTZ



EO75

- 0.26mm dot pitch
- 95KHz f_{max}
- 1600x1200 @ 75Hz max

\$730**



EO40

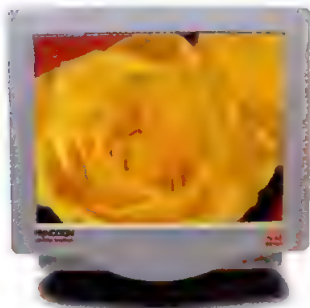
- 0.28mm dot pitch
- 48 KHz f_{max}
- 1024x768 @ 60Hz max

\$246**

EO50

- 0.28mm dot pitch
- 70KHz f_{max}
- 1280x1024 @ 60Hz max

\$341**



EO74T

- 0.25mm Aperture Grill
- 65 KHz f_{max}
- 1280x1024 @ 60Hz max

\$630**

EO76T

- 0.25mm Aperture Grill
- 86KHz f_{max}
- 1600x1200 @ 66Hz max

\$730**



EO70

- 0.28mm dot pitch
- 70KHz f_{max}
- 1280x1024 @ 60Hz max

\$575**

EO17

- 0.26mm dot pitch
- 70KHz f_{max}
- 1280x1024 @ 60Hz max

\$623**



EO72

- 0.26mm dot pitch-Microfilter
- 70KHz f_{max}
- 1280x1024 @ 60Hz max

\$682**

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CIRCLE 039 ON READER SERVICE CARD OR GO TO WWW.PCMAG.COM/BuyerLink

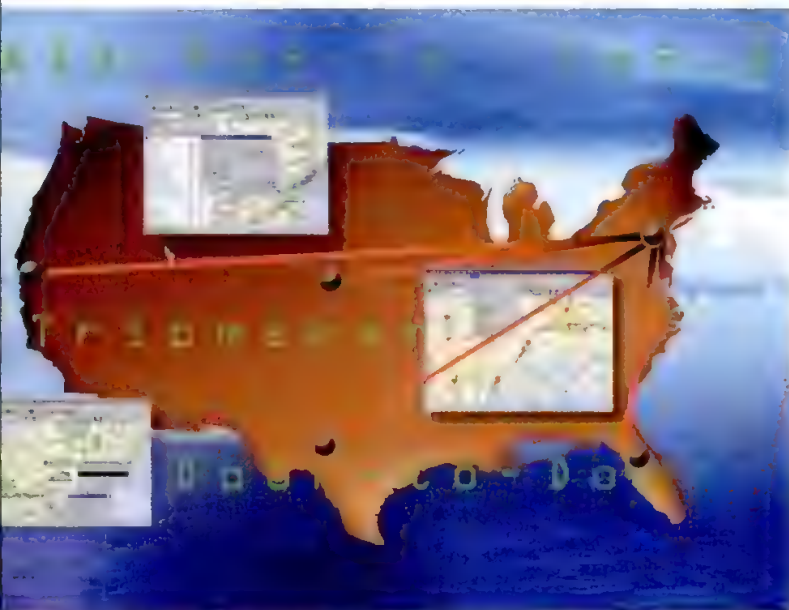
First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

MAPPING

On the Road Again

Software that gets you from here to there.—By Bruce Brown



Planning a trip? Not sure where you want to go or how to get there? Whether it's across town for a delivery or across country for a family reunion, the latest generation of mapping and trip planning software can take much of the guesswork out of arranging and taking your next trip.

Although we're not quite ready to throw away our paper maps, the newest mapping programs can help you organize excursions, suggest the most efficient or scenic route, and even retrieve updated road information from the Web. We tested DeLorme Mapping's \$40 AAA Map 'n' Go 2.0, TravRoute's \$50 Road Trips Door-to-Door, 1997 Edition, and Rand McNally's \$40 TripMaker 1997 and found that all three mapping programs offer the basics. You can select and plan a reasonably complicated trip, with parks and attractions along the way, zoom in and out to show more or less detail, and print the final map in a variety of formats.

In testing with two separate trips, the three products produced similar—though not exactly the same—routes, with some variation in mileage. What distinguishes these

products is their unique features and abilities.

SATELLITE SIGHT

Map 'n' Go sets the pace by linking to the system of orbiting global positioning satellites (GPS). If you have a GPS receiver and can get a line of sight view of three of the system's two dozen orbiting satellites, Map 'n' Go can tell you something the others can't: where you are.

After you make the satellite connection, Map 'n' Go shows your position to within about 50 feet on a map. On a practical level, GPS helps with daily trip planning, because the software tracks your progress, indicates travel direction, and even figures average speed.

There's a bonus for those who hate to stop and ask directions. If you're lost, the GPS add-on can help you get back on your way. What GPS can't do is overcome the limitation of notebook screens that typically get washed out in direct sunlight. For the time being, GPS will be a valuable mapping extension for the passenger—not the driver—to use.

Of the three products, TripMaker has the most extensive collection of destinations, events, and attractions to draw from. The program also lets you update current trip data directly from Rand McNally's

Web site. On the other hand, Door-to-Door includes the best street atlas of the three, and it can provide directions to and from specific street addresses. The other two vendors sell optional street-map programs, which roughly double their prices, making Door-to-Door a bargain.

To gauge how well

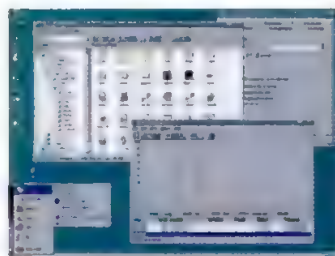
YOU ARE HERE: GPS receivers, such as this Garmin device, tap into a fleet of orbiting global positioning satellites to determine your position. The receiver plugs into your notebook and relays your position to the mapping software, which shows it on-screen.



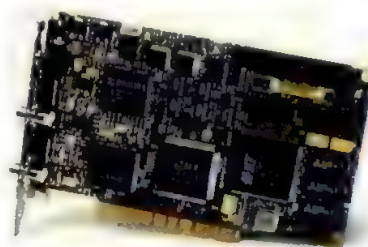
INSIDE

POWER WINDOWS:

Microsoft Windows NT 4.0 offers the look and feel of Windows 95. See page 44.



DON'T TOUCH THAT DIAL: TV tuner cards deliver broadcast television to your PC and capture live video. They may be the couch potato's ultimate peripheral. Page 50.



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First Looks Online

From October 21 to 25, go online to discuss mapping software with contributing editor Bruce Brown and representatives from DeLorme, Microsoft, Rand McNally, and TravRoute. Type GO EDITOR on CompuServe.



ILLUSTRATION BY JOHN BLACKFORD; PHOTOGRAPHS BY THOM O'CONNOR

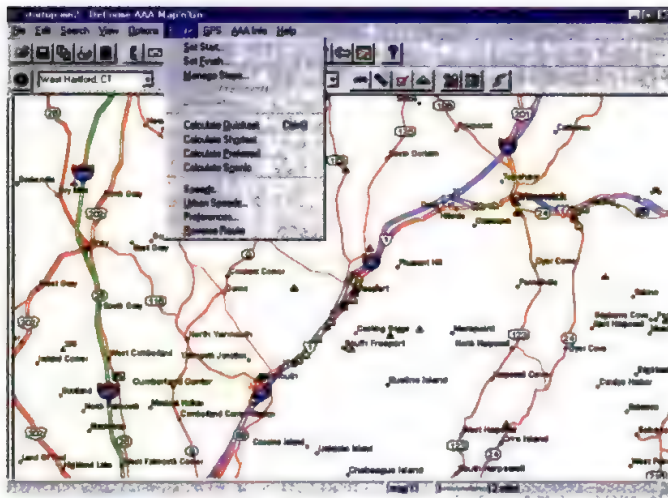
First Looks

these programs handled their routing and map-making tasks, we tested them with a Micron Transport 133-MHz Pentium notebook. We timed how long it took to route two-leg and three-leg trips, as well as how long it took to print the resulting maps on ink jet and laser printers.

Because few travel plans are carved in stone, we also tried adding stops to existing trips, edited stopovers, and used each program's tools to avoid specific roads. This is helpful if, for example, you want to avoid taking the McKinley Bridge over the Mississippi River but still get from St. Louis to Chicago.

In addition to our three reviews, we offer a sneak peek at a beta version of Microsoft Automap Trip Planner, 1997 Edition, which wasn't ready in time for our story. None of the three products we review finds the closest cash machine or public restroom, or makes sure you start with a full tank of gas, but each will be a productive traveling companion. Door-to-Door provides the best street-level maps and directions, while TripMaker 1997 includes unsurpassed attraction information.

But if you need to know where you are and where you're



QUICK AND CLEAN: The quickest way to set up a trip with Map 'n' Go 2.0 is via the Route pull-down menu. Just set your origin, destination, and stops.

heading, the combination of GPS and the versatility of AAA Map 'n' Go can't be beat.

DeLorme Mapping

AAA Map'n'Go 2.0



PC
MAGAZINE
EDITORS'
CHOICE

tions, campgrounds, and restaurants. And you can link to the company's Web site or to a GPS receiver.

While the minimum installation of Map 'n' Go takes just 9MB of hard disk space, we recommend the 20MB installation because it speeds program response. When you run Map 'n' Go, the program always loads your last trip with its directions and maps. You can zoom in and out of maps—at 15 levels, down to 1:24,000 scale at the highest resolution. This granularity is

AAA Map 'n' Go 2.0

List price: \$40. Requires:
8MB RAM,

**9MB hard disk space
Microsoft Windows 3.1,
Windows 95, or Windows NT;
for GPS: Garmin 30 or 45
Trimble Scoutmaster or fully
compatible NMEA receiver**

DeLorme Mapping, Freeport, ME
800-452-5931; fax, 207-865-9291

www.delorme.com

Circle 434 on reader service card.

matched only by Door-to-Door's.

You set up a trip by working through a series of dialog boxes for the trip's starting point and destination, and the stops you'd like to make along the way. The program provides options for selecting or avoiding certain roads along your route. For example, it is easy to steer clear of an expressway that you know is generally crowded or make sure you use a favorite road.

You can't plan a trip using specific street addresses, but you can pinpoint a destination based on its street address or get a rough idea of its location by using an area code and telephone exchange. DeLorme's \$45 Street Atlas and \$39 Phone Search USA can be used in conjunction with Map 'n' Go to locate specific addresses

Microsoft Takes to the Road

Microsoft Automap Trip Planner, 1997 Edition wasn't ready in time for our testing, but a beta version of the \$50 product indicates that the program will pick up where the three reviewed products leave off.

Trip Planner rivals **TripMaker** in depth of attraction information and goes one better by including samples of regional music and 360-degree panoramic views of selected spots; it doesn't have videos of attractions, though. **Trip Planner's** travel information includes 5,000 attractions especially for kids, as well as national parks, historic sites, and museums. It even lists outlet malls, and bed and breakfasts. Included articles from Moon Publications' travel books add regional information, and a Classic Drives feature lets you choose from popular tours in various regions of the country.

The program doesn't have

street-level maps. To do exact door-to-door routing, you'll need **Automap Streets Plus (\$50)**, which includes address matching and the ability to customize local and route maps. **Streets Plus, Deluxe Edition (\$75)** includes **American Business Information's American Yellow Pages**. **Trip Planner** does include GPS support and is heavy on Internet features with many listed links.

If you run out of gas often, Trip Planner has an answer. When you configure your personal profile, you tell Trip Planner the size of your gas tank, your average city and highway gas mileage, and the level of your gas tank at departure. The printed directions for the trip then include prompts for gas stops.

Microsoft Automap Trip Planner 1997 (800-426-9400; www.microsoft.com/automap) should be on

store shelves sometime this fall. And for those who like Automap Trip Planner, Microsoft makes it easy to stay current with annual updates for \$24.95 per year.—BB



WHERE TOP Trip Planner's screens display colorful maps with directions that include calculated gas stops.

First Looks

and plan your trips using them.

Once Map 'n' Go defines your trip, it calculates your preferred route or the quickest, shortest, or most scenic way to get to your destination. Map 'n' Go presents more choices than the other two programs, but its calculations take longer: 18 seconds for our short, three-leg trip and 12 seconds for our long, two-leg trip. You can print a single overview map or what Map 'n' Go calls Travel Pack—directions, detail maps, or a strip map that will be familiar to AAA members. You can also print information about selected attractions and destinations.

The maps produced on our color ink jet printer looked better than monochrome laser-printed ones, but both were usable on the road. Of the three programs, Map 'n' Go makes the best use of color, a factor that contributed to its long ink jet printer times.

If you attach a supported GPS receiver to your computer, Map 'n' Go shows your position and direction on-screen as a green arrow. In several trials using two different GPS receivers, Map 'n' Go consistently marked our car's location correctly. DeLorme uses its Web site to great advantage by supplying updated road and attraction information. Unfortunately, the site doesn't provide as much information as Rand McNally's.

Simple to use with excellent connectivity, AAA Map 'n' Go is the leader in trip-planning software.

TravRoute Software Road Trips Door-to-Door

TravRoute Software's Road Trips Door-to-Door compensates for its lack of multimedia files on attractions and destinations by including a complete street atlas and exact routing. Door-to-Door features 95 million home and business street addresses, 200,000 cities, towns, and ZIP codes, and almost 7 million miles of highway and street maps. Rather than simply plotting a route between cities or towns, Door-to-Door pre-

Editors' Choice

• AAA Map 'n' Go 2.0



Since the time of Mercator, the paper map has been the traveler's best

friend. Today, the PC adds to the mapping experience with beautifully detailed, dynamic maps that can include extensive planning features, descriptions of attractions and stopovers, and links to global positioning satellite (GPS) systems and the Web. Among the three packages we looked at, DeLorme's AAA Map 'n' Go 2.0 is the best implemented and connected, and it's our Editors' Choice.

Through a link to the GPS system, the program lets you know not only where you're going, but where you are and where you've been. While Map 'n' Go won't keep you from getting lost, it can get your excursion back on track. DeLorme also uses the Web to great ad-

vantage, providing updates that augment the program's extensive lodging, campground, and restaurant ratings.

The other two programs are not as well-rounded and are more focused on specific audiences. Because of its extensive database of attractions and destinations, Rand McNally's TripMaker 1997 is best for planning family trips and vacations. The program makes good use of the Internet by linking to relevant Web Sites to gather information, and it has unmatched information on

attractions and destinations. TripMaker suffers from the lowest map resolution of the three tested products, and neither TripMaker nor Door-to-Door can use a GPS receiver. Door-to-Door is the map-

ping bargain of the group. Although it costs \$10 more than the other products, Door-to-Door includes street-level maps as well as an atlas of the United States and trip-planning features that come as high-priced options for the other programs.



compares precise directions from start to finish.

The program uses up to 80MB of hard disk space and requires two CD-ROMs—one for installation, the other for the program. To plan a trip, you open a single window with three tabs: Trip Start, Trip End; Intermediate Stops; and Options. The last choice lets you enter speed limits and indicate

whether you want the quickest, shortest, or preferred route. You can set preferences on a scale from 1 to 10 for each of eight route types, from multilane, no-toll roads to ferry service.

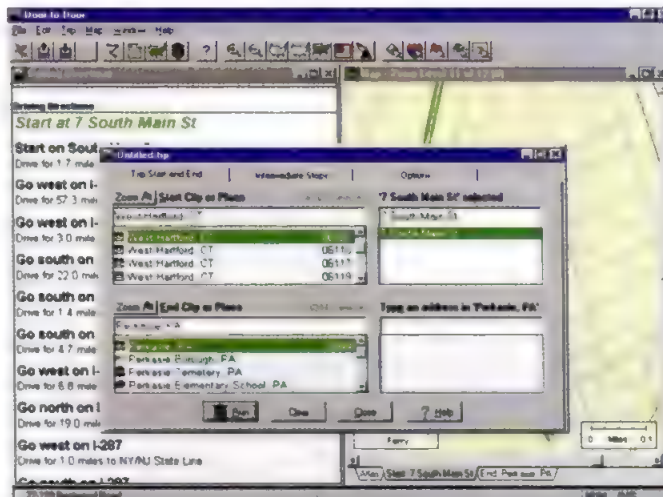
Using exact street addresses, our short, three-leg trip took 27 seconds to calculate, but when we used only city names (as we did with the other two programs), the

time was a competitive 9 seconds. A long, two-leg trip took just 8 seconds. Door-to-Door includes less color and map detail than the other two programs, so its printing times were fastest. Ink jet and laser maps and directions were easy to read; unlike the other programs, Door-to-Door prints maps and directions on separate pages.

On-screen maps can be viewed at 12 zoom levels, to a resolution of 1:24,000, with 7 levels of detail per zoom level. Door-to-Door's atlas lets you select from a long list of features including monuments, water recreation areas, parks, railroads, and schools.

There isn't much information for the tired or hungry traveler in Door-to-Door, but you can add 25 favorite stops to the program.

PC ROAD TRIP: Door-to-Door uses a simple table for setting origins and destinations. There are three types of route preferences, and you can enter the speed limits for roads along the way.



Road Trips Door-to-Door

Street price: \$50. Requires:

8MB RAM (16MB recommended)

60MB hard disk space

Microsoft Windows 95

or Windows NT

TravRoute Software, Princeton, NJ

800-297-8728; fax, 609-252-8168

www.travroute.com

Circle 435 on reader service card.

First Looks

TravRoute's Web site has general company and product information plus a modicum of travel data, but it is not the font of information that Map 'n' Go's and TripMaker's are.

Loaded with street-level precision, Door-to-Door is for people who want maps, and maps only.

Rand McNally

TripMaker 1997

Brimming with videos, pre-planned scenic tours, information on thousands of attractions, and the ability to control and track travel costs, TripMaker 1997 is a family vacation mother lode.

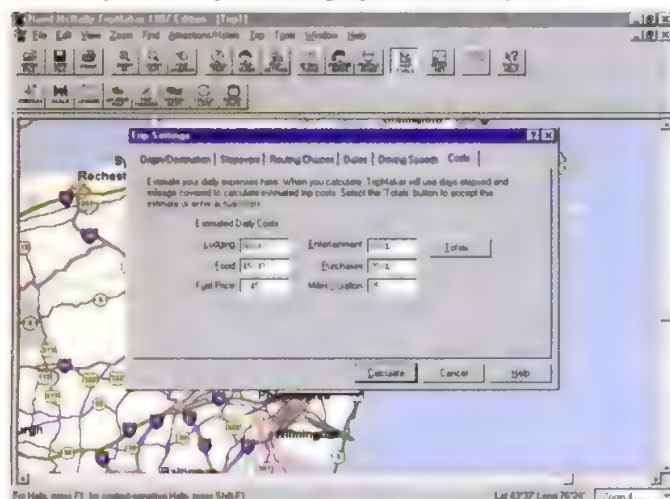
Installing the program for maximum performance uses 40MB of

hard disk space; a minimal installation needs 12MB. And one unique feature lets you create a floppy disk set of your trip, which includes roads and routing but neither attractions nor multimedia, for use with your notebook PC.

Of the three products we reviewed, TripMaker has the most helpful and interactive user interface. You can select wizards to walk (and, thanks to built-in audio, talk) you through the map-making process. Trip Maker's on-screen cartoon ranger gives novices a lot of help but may be annoying to seasoned travelers.

If you need to plan a trip in a hurry, TripMaker offers you two choices: Quick Trip (where you

TRAVELER'S CHECKS: A unique feature in Rand McNally's TripMaker 1997 is its ability to track trip costs, using expense estimates you set.



Mapping Software: Side by Side

	AAA Map 'n' Go 2.0	Road Trips Door-to-Door	TripMaker 1997
■ YES ■ NO			
Red type denotes Editors' Choice			
Calculates trip costs	■	■	■
Details on lodging/restaurants	■	■	■
Details on parks/attractions	■	■	■
Global positioning satellite support	■	■	■
Includes street/U.S. atlas	■	■	■
Quickest/shortest route selection	■	■	■
Scenic/preferred route selection	■	■	■
Travel speed control	■	■	■
Web update of maps	■	■	■
Zoom levels/Highest resolution	15, 1:24,000	12, 1:24,000	9, 1:125,000

enter just origin and destination) or Trip Settings (where a window opens with tabs for origin/destination, stops, routing preferences, speeds, travel dates, and costs). You can also set price levels for hotels and restaurants so only those that fit your profile are displayed. In addition, Trip Maker lets you set up multiple personal profiles, so that Mom, Pop, and Junior can each customize the program.

TripMaker took 7 seconds to run our short, three-leg trip and

8 seconds for the long, two-leg trip. Printing was also pretty fast, just a little slower than Door-to-Door on both ink jet and laser printers.

You can view maps on-screen at 9 zoom levels, down to 1:125,000 scale, which is a much wider but less detailed view than the other two programs offer. Unlike Door-to-Door, TripMaker doesn't give street-level directions; you can use Rand McNally's \$50 StreetFinder 1997 for exact routing.

TripMaker uses the Internet for updating road conditions and event information, and for researching destinations. Many attractions have an icon for a connection to the Rand McNally Web site, but the company doesn't control content, so expect variations.

TripMaker doesn't zoom to the same level as the other two programs, but it's the choice for planning family trips. □

TripMaker 1997

Street price: \$40. Requires:

8MB RAM

8MB hard disk space

Microsoft Windows 3.1 or

Windows 95

Rand McNally New Media, Skokie, IL

800-333-0136, ext. 6395; fax, 847-675-6368

www.randmcnally.com

Circle 436 on reader service card.

PERFORMANCE TESTS

Mapping



Of the three programs we looked at, Road Trips Door-to-Door was the fastest at producing and printing maps, but it lacked some of the detail of AAA Map 'n' Go. In most cases, performance differences among the three programs were insignificant.

To evaluate these mapping programs, we timed multiple trips for two journeys

and assessed map print quality and printing time with both ink jet and laser printers.

Using the quickest-route option, we timed how long it took for each program to calculate a short three-leg trip of over 300 miles starting in West Hartford, Connecticut, and ending in Newfoundland, Pennsylvania, with two stops along the way. We used default road preferences and speeds and found that calculated trip distances varied from 309 to 323 miles. Because of its extensive street atlas, we tested Door-to-Door

twice; first with city-level locations and second using specific street addresses. The second method (not charted) took almost three times as long to calculate. We also timed the calculation of a nonstop cross-country trip from West Hartford, Connecticut, to Foster City, California.

We used an Epson Stylus Color 500 ink jet printer and an HP LaserJet III to test print time and quality. We set each program to print the entire package of maps and directions for our short trip.

Lower scores represent better performance.
Minutes:seconds

	Three-leg trip	Two-leg trip	Print map (ink jet)	Print map (laser)
AAA Map 'n' Go 2.0	0:18	0:12	4:42	3:20
Road Trips Door-to-Door	0:09	0:08	2:08	2:48
TripMaker 1997	0:07	0:08	2:13	2:50

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Did we mention price? Let's face it. At under \$2,000, you'd have to travel far and wide to find a notebook computer that can match the beauty and the brawn of the new TravelPro 180.



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WINDOWS NT

Power over Performance

Windows NT Workstation 4.0 presents power and advanced features but at the cost of performance.—By Jeff Prosis

Little more than a year ago, it seemed that Microsoft Windows 95 was poised to take over the computing world. Now it appears that its strongest competition may come from a Microsoft sibling, Windows NT 4.0. The bottom line is that the \$319 Windows NT Workstation 4.0 package includes a slew of new features, but it doesn't outperform Windows NT 3.51 on a variety of tasks.

If Windows NT is in your future, you'll need a PC with at least a Pentium CPU and 32MB of RAM or more. Windows 95 users will feel right at home with Windows NT 4.0, because the most obvious change is Windows NT's near-replica of the Windows 95 user interface: the Start button, taskbar, right-click context menus, and support for file viewers and other plug-in user interface components.

The most important new Windows NT services and application programming interfaces (APIs), include Telephony, Cryptography, DirectDraw, DirectSound, DirectPlay, DirectInput, and ActiveMovie. Windows NT 4.0 also supports the Distributed Component Object Model (DCOM), which lets OLE-enabled applications communicate as seamlessly across networks as they do on individual PCs. A new 486 emulator allows RISC workstations—Digital Alpha, for example—running Windows NT 4.0 to execute Visual Basic 4.0 and other applications that rely on the Intel platform.

For those who are Internet-inclined, Windows NT 4.0 includes Peer Web Services, a subset of Microsoft Internet Information Server, which enables desktop users to publish Web pages on corporate intranets without a dedicated Web server. What Windows NT 4.0 doesn't have is an up-to-date Web browser; it ships with Internet Explorer 2.0. Version 3.0 is available from Microsoft's Web site. Win-

dows NT 4.0 supports the new Point-to-Point Tunneling Protocol (PTTP), which lets users establish private, secure connections to corporate networks via the Internet.

The most controversial change to Windows NT is the relocation of large portions of GDI and User facilities—the OS components responsible for graphical output, window management, and directing message flow—from user mode to the more secure kernel mode. Running GDI in user mode protects the OS kernel from buggy video and printer drivers, but it extracts a price in performance.

To gauge the effect of these changes on real-world performance, PC Labs conducted a series of tests pitting Windows NT 4.0 against Windows NT 3.51 running such applications as AutoCAD, Adobe Photoshop, Mi-

crosoft Word and Excel, and Symantec C++ on a pair of PCs—a 133 MHz Pentium system and a 200 MHz Pentium Pro—with 64MB of RAM. The results were basically a wash. Windows NT 4.0 ran through our tests faster than Windows NT 3.51 on a series of Excel tasks and a large C++ compile, but you pay for that speed with lower performance on other applications.

Windows NT continues to place

shortcoming was driver support. Windows NT 4.0 still doesn't measure up to Windows 95 in this regard, but it supports a wider variety of hardware right out of the box than Windows NT 3.51 did.

That's not to say Windows NT 4.0 is perfect. On our 200-MHz Pentium Pro PC with Number Nine's Imagine Series 2 video card, Windows NT 4.0 was noticeably less snappy than Windows 95, apparently because of a slower video driver. And Windows NT's setup program mis-identified a common video card and failed to detect a Sound Blaster 16/AWE-32 sound card. Because of Windows NT's lack of Plug and Play, power management, wireless printing, and PC Card support, Windows 95 remains the Windows of choice for notebooks.

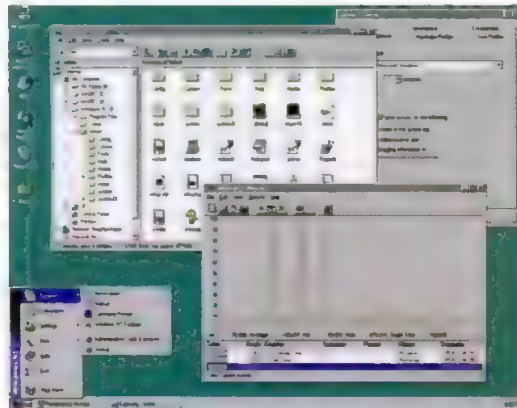
Existing Windows software should run under Windows NT 4.0

at least as well as it does under Windows 95, if not better. But Windows 95 runs some software that Windows NT can't—notably DOS games that require direct access to the video hardware.

The decision of whether to upgrade to Windows NT 4.0 isn't easy. Because Windows NT uses a different registry structure than Windows 95, and the Windows NT setup program doesn't migrate these settings; some 32-bit applications must be reinstalled before they work.

Is Windows NT 4.0 right for you? If you value security and reliability in an operating system above all else and have a Pentium or Pentium Pro PC with at least 32MB of RAM, then Windows NT deserves a look.

Microsoft Windows NT Workstation 4.0. List price: \$319; upgrade, \$149. Requires: 12MB RAM (16MB recommended), 10MB hard disk space, CD-ROM drive. Microsoft Corp., Redmond, WA; 206-936-8080; www.microsoft.com. Circle 428 on reader service card.



WINDOWS 95, NOT: Windows NT 4.0's sleek exterior mimics Windows 95's.

BENCHMARK TESTS

Windows NT Workstation 4.0



In terms of performance, the difference between Microsoft Windows NT Workstation 3.51 and Windows NT Workstation 4.0 depends on what application you use. Performance under Windows NT Workstation 4.0 was slightly better when working with Microsoft Excel and Symantec C++ but slightly worse with Microsoft Word.

We tested both versions of Windows NT on two PCs: a 133-MHz Pentium and a 200-MHz Pentium Pro. Each had 64MB of RAM. We timed a series of tasks using four applications and two Adobe Photoshop filters.

	133-MHz Pentium		200-MHz Pentium Pro	
	Windows NT 3.51	Windows NT 4.0	Windows NT 3.51	Windows NT 4.0
Microsoft Word	0:29	0:34	0:18	0:21
Microsoft Excel	0:46	0:38	0:26	0:22
Symantec C++	3:26	3:08	1:47	1:38
AutoCAD	5:51	5:43	2:36	2:53
Adobe Photoshop Gaussian Blur	0:32	0:39	0:15	0:14
Adobe Photoshop Lighting Effect	0:58	1:10	0:39	0:51

Lower scores represent better performance.

Minutes:seconds

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How fast is Sportster ISDN?

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"The Sportster ISDN 128K might have been named the Screamer. It was the only product in our test group to provide data compression, and this ISA-bus ISDN adapter, from U.S. Robotics, blew the other five products away on our performance tests." PC Magazine, June '96

"A top performer in our testing, the inexpensive, feature-rich Sportster 128K has 'buy me' written all over it... At only \$399, this internal adapter rockets you from place to place on the Internet at speeds of over 113 Kbps with none of the limitations imposed by a serial port." CNET, July '96

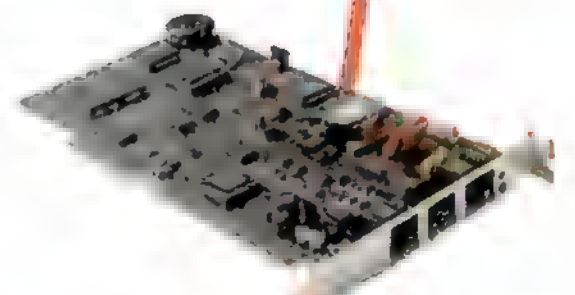
Let's just say light is starting to get jealous.

It's not surprising, considering the Sportster's features: TurboPPP™ provides compression up to 512 Kbps. The onboard analog port lets you connect a standard phone or fax, allowing you to talk or send/receive a fax simultaneously with data transmission.

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WINDOWS 95 GRAPHICS

PC Graphics Goes 3-D

HiJaak Pro 4.0 brings you impressive speed and 3-D functionality.—By J.W. Olsen

HiJaak Pro 4.0 strengthens and speeds up the previous version of the program, and adds compelling 3-D features to the mix. For those who partake of virtual reality and CAD, HiJaak's new benefits easily offset the product's \$279 price tag, which is nearly three times higher than that of its predecessor. Otherwise, such 32-bit alternatives as Paint Shop Pro and SnagIt may offer more bang for your buck.

HiJaak has four primary elements: HiJaak Pro, HiJaak Capture, HiJaak Catalog, and HiJaak Scan. There are useful Microsoft Windows 95 shell extensions as well as HiJaak Find, which works like a cross between a shell extension and a standalone program.

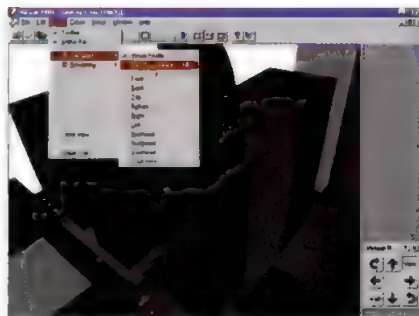
Most of the enhancements lie within HiJaak Pro. You can still view, print, edit, and convert 24-bit graphic files, but HiJaak now supports 3-D formats, displays PostScript Level 2 files, and converts back and forth between many 2-D and 3-D formats. You can extract 2-D slides from 3-D VRML .WRL files for a presentation. AutoCAD users can edit and convert their 2-D and 3-D files into other formats. Along the way, you can rotate and move through virtual-reality worlds from any perspective while editing in wireframe, flat, or gouraud mode. CAD tools shift perspective and move you nearer to or farther away from objects.

Capture, Catalog, and Find remain largely unchanged. Capture sends a screen, user-defined area, or desktop objects to HiJaak Pro, the Clipboard, printers, and files. Catalog creates thumbnail albums of images with information about them, including user-assigned keywords. In turn, a Find menu choice added to Windows 95's Start menu can locate cataloged files.

Quarterdeck has fixed a frustrating weakness in the previous version. You can now close the

Catalog icon in the Windows 95 task tray and disable cataloging and HiJaak's Windows 95 shell extensions, freeing up system resources. With graphics, Catalog can update albums in the background, so HiJaak's Find module and the clever shell extensions can work. With those extensions, image files can be displayed in My Computer or Explorer as oversize thumbnails; and when you right-click on the thumbnails, you can invoke HiJaak functions via context menus.

Scan's interface is spartan, but it coaxed the best output yet from our Logitech PageScan Color scanner. HiJaak now supports



3-D ADVENTURE: HiJaak Pro offers striking 3-D rendering capabilities, including virtual reality.

color mode, but images are saved correctly. Occasionally, a background window repeatedly jumps to the foreground when HiJaak Pro performs such actions as loading files. Minimizing the background window solves the problem.

Despite these minor annoyances and the price increase over its previous version, HiJaak Pro 4.0 is an easy choice for virtual reality or CAD users.



3-D WORLD: Catalogs, large thumbnails, and context-menu additions in HiJaak Pro 4.0 make finding the right file quick and easy.

multiple display interface (MDI) windows so you can access several graphics at once. And while HiJaak lags behind alternatives such as Paint Shop Pro and Microsoft Paint in speed, it's now faster.

HiJaak still sometimes displays objectionable dithering in 256-

HiJaak Pro 4.0. Street price: \$279. Requires: 8MB RAM (16MB recommended), 25MB hard disk space, Microsoft Windows 95. Quarterdeck Corp., Marina del Rey, CA; 800-354-3222; www.quarterdeck.com/. Circle 402 on reader service card.

INTERNET UTILITIES

The Finder of Lost Sites

HindSite keeps track of where you've been on the Internet, and it can help with where you're going, too.—By Edward Mendelson

You want to revisit a Web site you saw a few months ago, but you didn't bookmark it and you can't remember its name or address. All you can recall is a few words from the page. ISYS/Odyssey Development's \$39.95 HindSite is the only utility available that can find the site.

HindSite automatically indexes the pages cached on your disk by Netscape Navigator. HindSite is kind to your hard disk because it doesn't save the pages themselves, just the index.

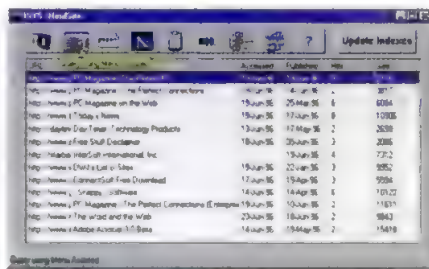
When you want to return to a page that's been indexed by HindSite, it doesn't matter if the page is still in the cache. You tell HindSite the words you want to find, either by entering a plain-English query or by constructing a Boolean search in a dialog box and the program displays a list of Internet addresses, complete with the dates you visited them and the dates the pages

were originally created. A double-click on an item in the list opens that page in Navigator.

Convenient as it is, HindSite has its shortcomings. Unless you're using the 16-bit version of Navigator, you'll have to update HindSite's index periodically. Its index expands indefinitely until you manually tell it to remove old references; the default period for removal is six months. And the program has no keyboard interface, so you must use its toolbar.

But you'll probably be willing to live with these problems. Although many utilities exist that index your current Navigator cache, HindSite is the only one that remembers sites that disappeared from it long ago.

ISYS HindSite. List price: \$39.95. Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1, Netscape Navigator 2.x. ISYS/Odyssey Development Inc., Englewood, CO; 800-992-4797, 303-689-9998; www.isysdev.com/. Circle 401 on reader service card.



INTERNET ELEPHANT: HindSite remembers Web sites you visited months ago. But there is no keyboard interface so you must use HindSite's toolbar.

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A large industrial facility, likely a semiconductor manufacturing plant, with a computer system in the foreground. The background shows a vast, multi-story building with a complex facade of pipes and structural elements. In the foreground, a desktop computer system is displayed, including a CRT monitor, a tower unit, a keyboard, and a mouse. The monitor shows a website with the Micron logo and the text "Welcome to Micron Electronics™". The overall scene suggests a connection between advanced manufacturing and digital technology.

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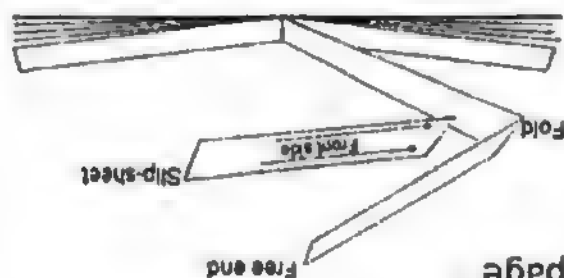
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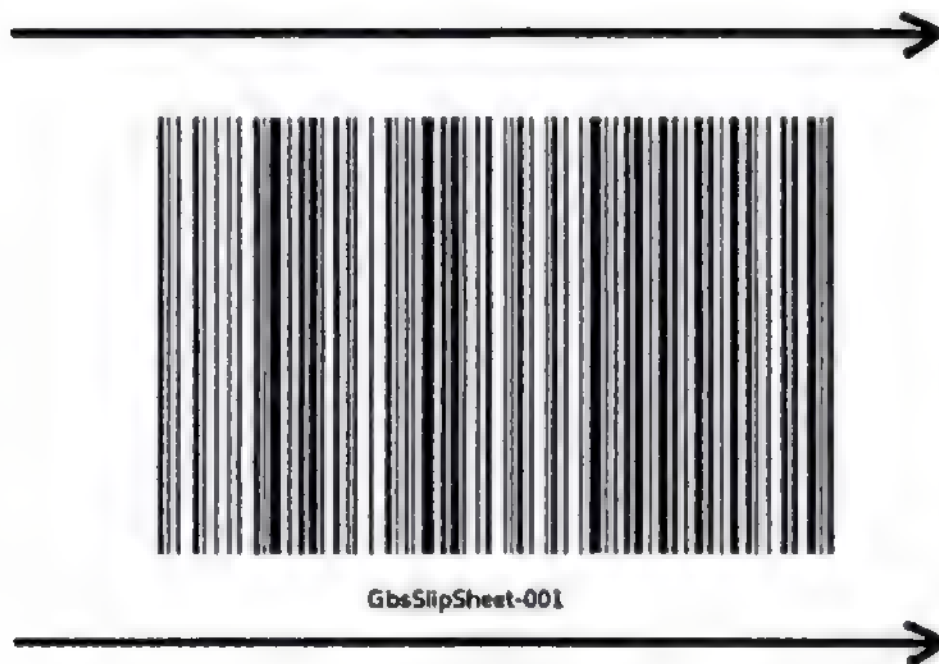


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- 4. Close the page and slip-sheet**



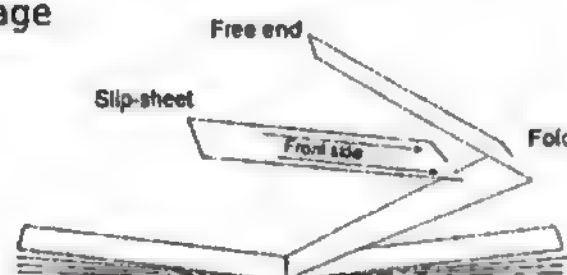
Inverted Foldout Slip-sheet



Folded edge of the page

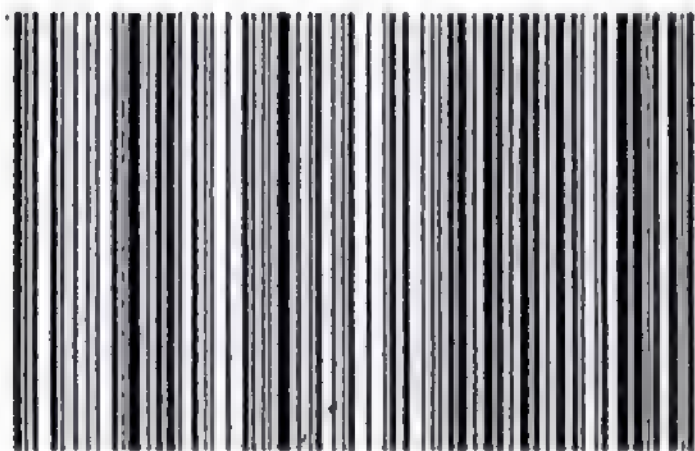
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



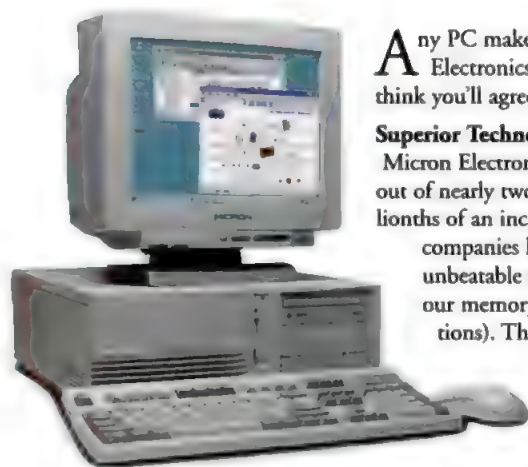
Gbs5lipBack-0018

Back

1. Follow instructions on the other side



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Source: *PC World* Reliability & Service Monitor, May 20 - November 20, 1995

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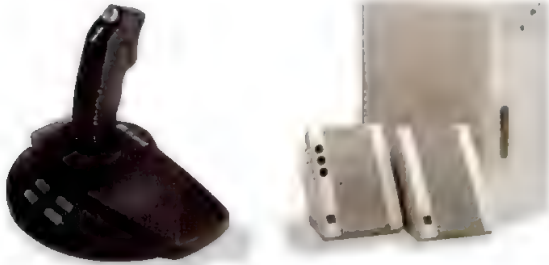
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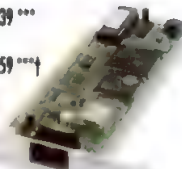
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VIDEO ACCESSORIES

Channel Surfing, the PC Way

TV tuner cards transform your PC into a window on the broadcast television world.—By Rick Broida

Seen anything good on your PC lately? With a TV tuner card installed on your PC, you can put ESPN in a window, watch full-screen aerobic training, catch the latest stock-market reports, or just indulge that secret addiction to "Days of Our Lives."

From a more practical standpoint, these television-tuner add-in boards allow you to capture frames from live video sources. Some models can also record full-motion video. The four TV tuner devices we tested, Hauppauge's Win/TV CinemaPro, Logicode's TVideo, the Mitumi VB-501 PC TV, and the Philips PCA20TV, are designed to work with your existing graphics card and range in price from \$199 to \$400.

Two of them require a 26-pin feature connector, something not all graphics cards possess. The other pair simply commandeer the card's VGA port, guaranteeing compatibility with virtually any system.

We tested these tuners alongside an STB Horizon Plus, a mainstream PCI graphics card with 2MB of video memory. Each card was able to work with NTSC and PAL signals and could receive 125 cable channels. The overall quality ranged from barely acceptable to that of an inexpensive color television.

With one exception, all the tuners performed admirably and provide a way to watch TV while you're hard at work.

WIN/TV CINEMAPRO

Hauppauge Computer Works' \$299 Win/TV CinemaPro is a plug-and-play tuner designed for Microsoft Windows 95 and Windows NT; our test-bed system immedi-

ately recognized and correctly configured the card. The three-quarter-length ISA device accepts TV, composite, and S-Video input in NTSC or PAL (but not SECAM) formats. It does not require a feature connector to work, and it supports resolutions from 640 by 480 to 1,280 by 1,024; 24-bit color is available in any resolution.

The software controls are quite flexible: You can switch to a full-screen display without borders by simply clicking on the right mouse button. Chroma-key

The video software includes the obligatory on-screen channel control, which automatically scans for up to 125 available cable channels. The CinemaPro delivered crisp video, but the colors seemed washed out at times. Fiddling with the saturation settings improved the color quality considerably.

In addition to capturing individual frames, the CinemaPro can record full-motion video in Windows' .AVI format. A crude applet allows you to capture live video at resolutions of up to 640 by 480 and as many as 24 frames of video per second, which



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Rick Broida.

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TVVIDEO

If you prize a sharp picture and vibrant color above all else, Logicode's \$230 TVideo is for you.

The half-length ISA card supports noninterlaced resolutions from 640 by 480 to 1,280 by 1,024, and 24-bit color at resolutions of up to 800 by 600. Your graphics card must have a feature connector to work with the TVideo card, and

you need to buy a cable to connect the device to your sound card to get audio. We supplied one and discovered an unusual glitch: The audio stream remains active even after the tuner software is closed.

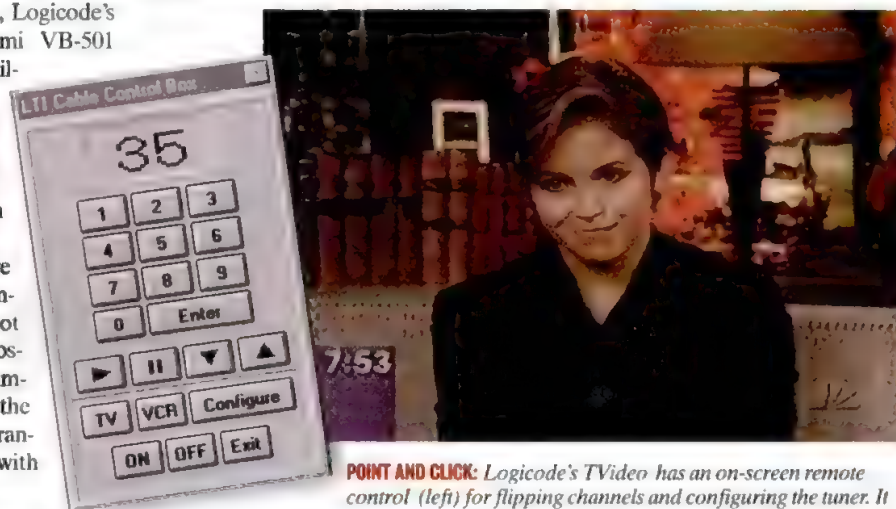
The only way around this phantom sound track was to unplug the cord from our PC's audio card.

The TVideo supports NTSC and PAL (but not SECAM) formats, and it can access 125 cable channels. Video input sources are limited to cable/antenna and composite.

Logicode's confusing Windows 3.x software is the weak element in the package. The LTI-Tuner lets you view and capture video images, and it supplies an on-screen remote control for flipping channels

and configuring the tuner. LTI-Video is the same program, but without the remote-control pointer. Both utilities give you access to the TVideo's settings, which include brightness, saturation, and chroma- and color-key overlays. Logicode also bundles two odd extras: SoftKey's CNN Newsroom, a topical CD-ROM atlas, and PicPress, a shareware image-compression utility. The TVideo does its best work as a video player. But it can't record full-motion video, and captured still frames can be exported only as 256-color or 24-bit bitmap files.

Nevertheless, the TVideo produces exceptional color and



POINT AND CLICK: Logicode's TVideo has an on-screen remote control (left) for flipping channels and configuring the tuner. It captured some of the sharpest video among the cards we tested.

overlays are available but only in such third-party applications as Gold Disk's Video Director and Microsoft's PowerPoint.

The loopback cable that connects the CinemaPro to your graphics card and monitor also branches out into a hydra of six RCA jacks—two for audio input, two for video input (luma and chroma S-Video), and two for composite and S-Video output. The latter require an optional video encoder module. Of the four, the CinemaPro is the only TV tuner we looked at that includes an audio cable for connecting the system to a sound card.

is pretty good for a card in this price range. Hauppauge sells a 32-bit programmer's toolkit that lets you add video overlay or image capture to custom applications.

Despite a couple of rough spots, the CinemaPro is an excellent TV tuner for your PC. **Win/TV CinemaPro.** List price: \$299. Requires: 8MB RAM, 1MB hard disk space, 16-bit ISA slot, Microsoft Windows 3.1, Windows 95, or Windows NT. Hauppauge Computer Works, Hauppauge, NY; 800-443-6284, 516-434-1600; www.hauppauge.com/hcw/index.html. Circle 424 on reader service card.

First Looks

a picture that's as crisp as a TV's. **Video.** List price: \$230. Requires: 4MB RAM, 3MB hard disk space, 16-bit ISA slot, feature connector, Microsoft Windows 3.1 or later. Logicode Technology, Camarillo, CA; 800-735-6442, 805-388-9000; www.logicode.com. Circle 425 on reader service card.

MITSUMI VB-501 PC TV

On paper, Mitsumi's VB-501 PC TV is a powerful TV tuner capable of receiving as many as 181 cable channels and capturing full-motion video. In reality, the \$199 card is bogged down by poorly designed software and presents mediocre image quality.

There's one frustrating hurdle to clear when installing the three-quarter-length ISA card: the too-short ribbon cable that links the VB-501 to your graphics card's feature connector. The two cards must be parked in adjacent slots for the cable to work. Although the VB-501 supports only two IRQ settings, the default worked fine on our test-bed.

The VB-501 supports noninterlaced resolutions of up to 800 by 600, and 1,024 by 768 in interlaced mode. At 640 by 480, the card can display 24-bit color; at other resolutions, it's limited to 256 colors.

Video quality was inferior to that of the other cards and to that of a standard TV as well. The default settings for brightness and color-gain resulted in noticeable image bleeding at the edges, an effect we couldn't completely eliminate by adjusting the settings. Furthermore, the video becomes pixelated when enlarged to full screen, making it unsuitable for presentations. None of the other tuners suffered from this problem.

On the positive side, the VB-501 offers a variety of audio modes, including pseudo-stereo and spatially enhanced stereo. There's no cable included to connect a sound card to the tuner, but the nifty audio effects work with any sound card.

Mitsumi's tuner software em-

ploys nonstandard dialog boxes and oddly arranged menus. Screen captures are easy to perform and may be saved in bitmap, YUV, or TGA formats. The video-capture applet can record live video at resolutions of up to 640 by 480. It supports six different compression schemes but dropped many more frames than Hauppauge's

CinemaPro under comparable conditions. A saving grace is Mitsumi's inclusion of Adobe Premiere LE video editing software.

Woefully sparse documentation is compensated for with a low price tag. The VB-501 is for those installations where its price is right.

Mitsumi VB-501 PC TV. List price: \$199. Requires: 4MB RAM,

control's sensor jack. Because the PCA20TV doesn't require a feature connector, it's compatible with virtually every graphics card. What's missing is the cable needed to connect the tuner to your sound card.

The PCA20TV supports composite video, S-Video and TV-tuner sources, as well as PAL, NTSC and SECAM formats. You can choose between interlaced output (for TV and VCR viewing) and noninterlaced output (for video game systems). The tuner is limited to resolutions of 640 by 480 and 800 by 600 but can produce 24-bit color in both modes.

Philips includes software for DOS and Windows 3.x but not Windows 95. Unfortunately, only the DOS utility can change the card's interrupt and I/O settings, but the defaults worked

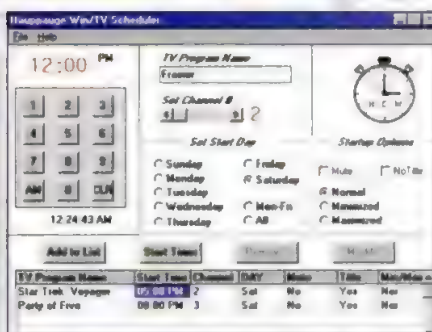
fine with our test-bed system. The software provides a full range of image control tools, including chroma-key and color-key overlay effects. The handheld remote duplicates most of the functions of the on-screen version.

The PCA20TV is able to capture individual frames but not streams of full-motion video. Because the software is compatible with Twain-compliant applications, you can capture a frame just as you would scan a photo.

The tuner produced acceptable color, but we noticed slight picture degradation when there was a lot of movement within the source video. Nevertheless, with its easy installation and remote-controlled operation, the PCA20TV is an admirably high-tech way to add TV to your PC. **Philips PCA20TV.** List Price: \$235. Requires: 4MB RAM, 2MB hard disk space, 16-bit ISA slot, Microsoft DOS 5.0 or later, or Windows 3.1 or later. Philips Professional Solutions, San Jose, CA; 800-235-7373, 408-453-5129; www.philips.com. Circle 427 on reader service card.



TV GUIDES: The Mitsumi VB-501's tuner software (top) had an odd interface that took some getting used to. Hauppauge's WinTV CinemaPro (right) allows you to schedule live video captures. Philip's PCA20TV (above) includes both an on-screen remote and a hand-held version.



4MB hard disk space, 16-bit ISA slot, feature connector, Microsoft Windows 3.1 or later. Mitsumi Electronics Corp., Irving, TX; 800-648-7864, 214-550-7300; www.mitsumi.com. Circle 426 on reader service card.

PHILIPS PCA20TV

Philips Professional Solutions' remote-controlled PCA20TV (\$235) can turn your PC into an entertainment center. Its TV-like control screen serves not only to flip channels but to select tracks on music CDs. Slide your favorite disk into your CD-ROM drive and you've got a remote-controlled stereo to go with your cable-ready TV.

The three-quarter-length ISA card requires two expansion slots—the second one is for a bracket that holds the remote

VIDEO-CAPTURE CARDS

Lights, Camera, Capture

With the proliferation of the PCI bus, video capture and editing on the PC has come a long way. —By Jan Ozer

When we last looked at video capture cards ("Shot by Shot," April 11, 1995), PCI was battling with VESA VL-Bus for bus supremacy, nonlinear editing systems started at \$6,000, and all of our reviewed boards were ISA bus cards barely capable of capturing 15 frames per second (fps) at 320-by-240 resolution. What a difference a year makes: These four PCI-based capture cards that cost less than \$1,500 each and can capture 30 frames of video per second.

At first glance, the \$1,495 Digital Video Arts WakeBoard Multimedia Pro, the \$1,099 Fast AV Master, the \$999 miroVideo DC30, and Truevision's \$799 Bravado 1000 are birds of a feather. They are bus master boards that can digitize video data with minimal CPU intervention. Each approaches professional-quality capture and increases video-capture data rates to as high as 5.1 MBps.

By complying with the Plug and Play specification, they largely eliminate installation hassles associated with earlier capture cards. All four boards include either Adobe Premiere or Ulead's Media Studio editing software. These programs provide such advanced nonlinear editing functions as titling and adding transitions, as well as supporting filters and special effects. Both programs also supply a compression interface to codecs—Cinepak or Indeo video interactive (IVI), for example—giving the developer the ability to distribute video on tape, in analog format, or on CD-ROM.

Although the four boards are similar in configuration, several offer unique features. For example, the AV Master and DC30 have on-board sound for better synchronization between audio

and video, further increasing data-capture rates. And the WakeBoard can perform real-time capture directly to the IVI format for fast prototyping of a video sequence. At \$799, the Bravado is the price winner, although you sacrifice some performance.

CAPTURE THE FLAG

Three primary factors differentiate video-capture boards: video quality, feature set, and ease of use. We tested on a PC running Microsoft Windows 95 with a 4GB RAID disk array, and we looked at the boards' bandwidth and quality of video.

Any of these boards will vastly outperform ISA capture cards. Each is simpler to install and yields good results more easily. We chose the DC30 as the best of the bunch for its overall capabilities.

WAKEBOARD MULTIMEDIA PRO

While Digital Video Arts' WakeBoard Multimedia Pro is unique in its ability to capture directly to

TrueSpace 2. Unlike the other boards in this review, the WakeBoard uses a wavelet compression digital signal processing (DSP) chip. The board offers both compressed and uncompressed capture modes.

The WakeBoard captures in three modes. It works with IVI—but produces only key (I-frame) and delta (P-frame) frames—not IVI's bidirectional, interpolated (B-frame) frames. The WakeBoard also supports Intel's YVU9 uncompressed mode. In addition, the board works with Wake Video, a proprietary codec used for nonlinear editing.

Maximum capture resolution is limited to 320 by 480, which is equivalent to a half-width NTSC signal. When it's time to move the sequence to tape, the board duplicates horizontal pixels for a full screen.

Installing this board was simple, although on-board sound support would have helped. We

ates nowhere near its stated maximum of 3 MBps. Even at 1 MBps, video streamed to tape was choppy, and its quality was clearly degraded. Though the WakeBoard's images were typically sharper than those produced by the other boards, frames were marred by subtle green traces. Cinepak footage was not as clean as with the other boards.

Real-time capture to IVI format was more rewarding. At 320-by-240 resolution and at 15-to-24-fps, we captured video at between 180 and 220 KBps, with very good results. Video quality was impressive, with minimal background noise or artifacts. Unlike Intel's venerable Smart Video Recorder Pro, which captures only key frames, WakeBoard also captures P frames, making the video instantly usable.

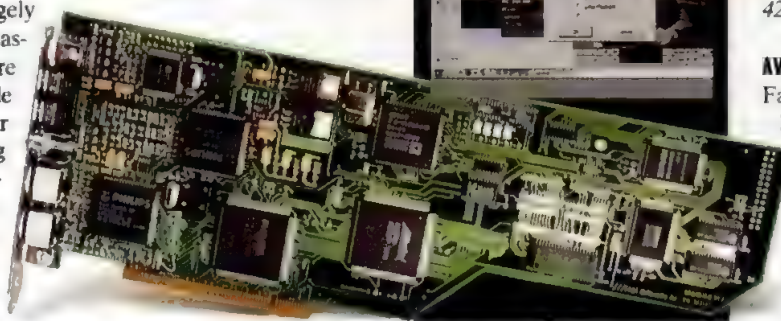
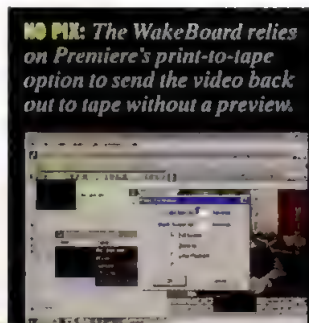
WakeBoard is a first-generation board that couldn't match the capabilities of more mature products. It's for those who need real-time capture capabilities. **WakeBoard Multimedia Pro.** List price: \$1,495. Requires: 16MB RAM, 500MB hard disk space, PCI slot, Microsoft Windows 95. Digital Video Arts Ltd., Jenkintown, PA; 215-576-7920; fax, 215-576-7932; www.drall.com. Circle 429 on reader service card.

AV MASTER

Fast's \$1,099 AV Master is a high-bandwidth board that produced excellent video on both our nonlinear editing and MPEG compression tests. The AV Master is a strong candidate for a variety of video applications.

The AV Master board uses Zoran's 36050 chip set for Motion JPEG compression and provides on-board audio capture via Analog Device's SoundComm 9605 chip. A separate ASIC provides hardware audio/video locking for rock-solid sound and video synchronization.

Capable of 640-by-480 resolution, the AV Master includes Ulead's Media Studio 2.5 video editing software, Crystal Graph-



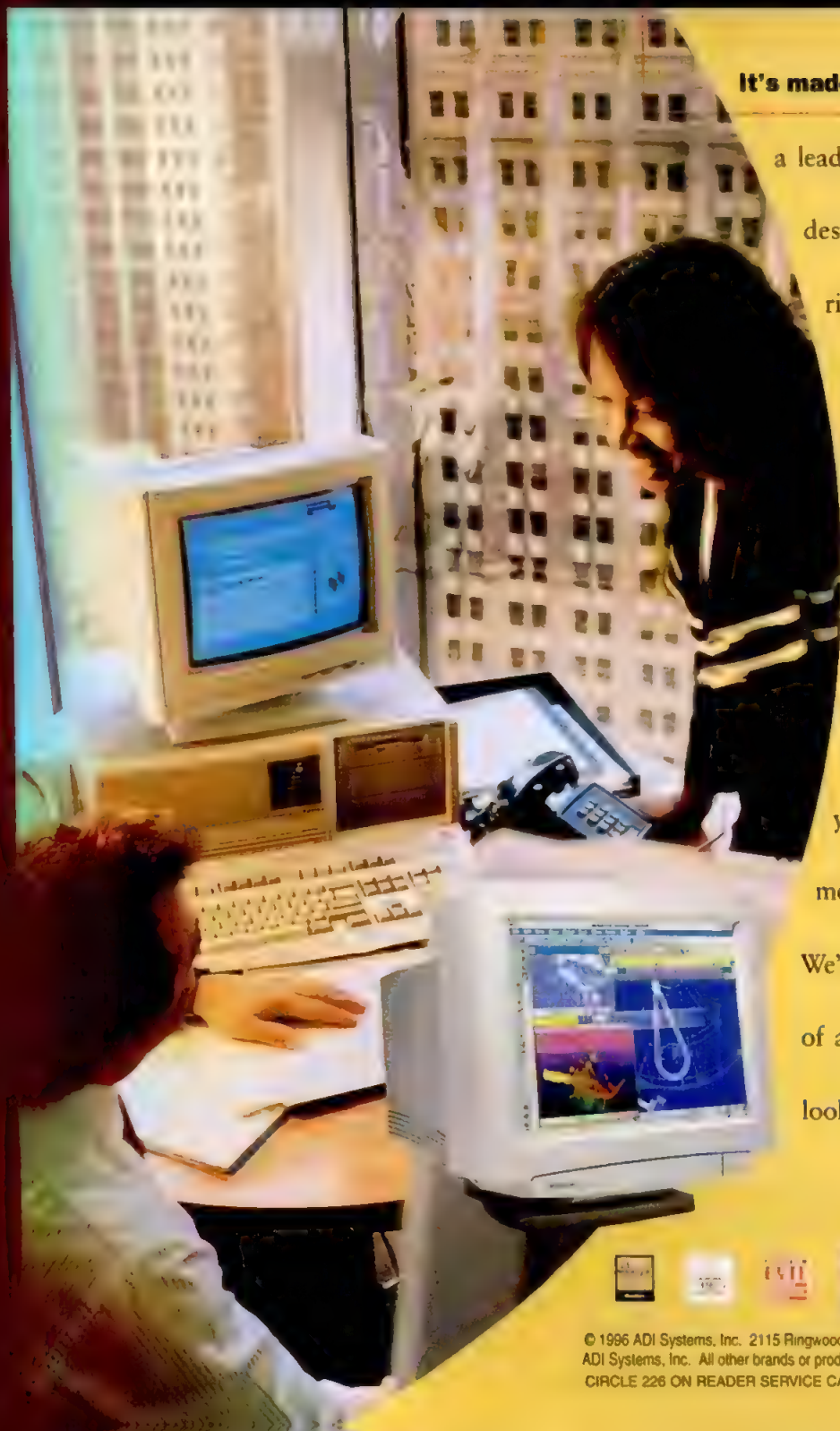
an IVI file for immediate prototyping and publishing, it did not perform as well on our capture and editing tests as the other three cards did.

The WakeBoard ships in two configurations: a \$995 package with Premiere LE and the \$1,495 bundle we reviewed, which comes with the full version of Premiere, Crystal Graphics Flying Fonts Pro 3.0, and Caligari

could get the system up and running only after removing our network card to make room. Working with the Wake Video format in Premiere felt sluggish. The WakeBoard was also slightly unstable and crashed several times during testing; Digital Video Arts promises to issue a maintenance release soon.

Nonlinear editing tests demonstrated that WakeBoard oper-

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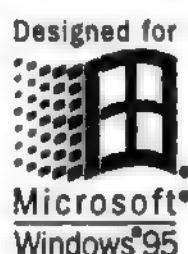
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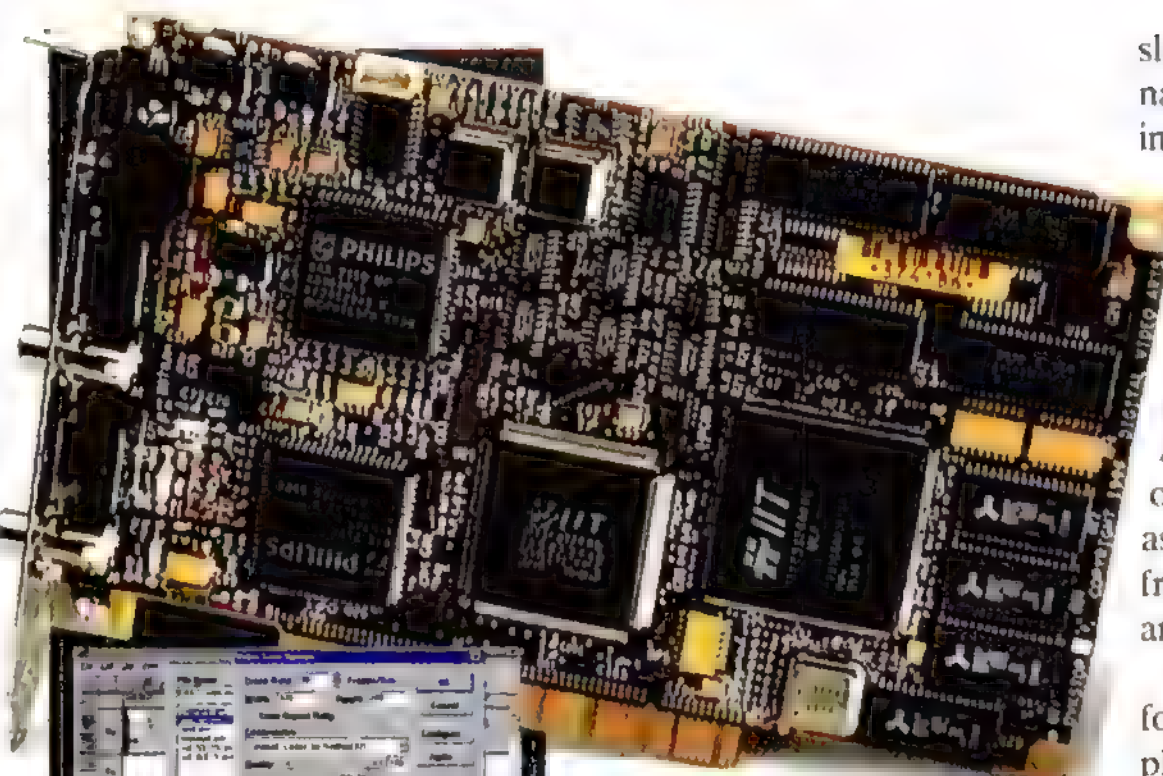
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First Looks

ics Flying Fonts LE, and a 32-bit version of VidCap. Fast Multimedia also provides MediaCache, a proprietary program that smoothes .AVI playback jitters when transferring digital video to tape.

The AV Master's controls are simple but effective: One button toggles between full-screen, field-based capture and 320-by-240-resolution frame capture. The data rate is controlled by a color-coded slider bar with digital readouts of frame size and data transfer rate. When the bar is green, capture is OK; orange means you're getting too aggressive; and red indicates you're outstripping the card's capabilities. The color keys were supposed to change according to the disk drive installed, but we noticed no change when we switched drives.

During several tests, the AV Master repeatedly stuttered over one test sequence and then stopped capturing video, though it continued to capture audio. No other board of the four had this problem. During capture



KEEPING IT: The AV Master gives you a variety of options when it comes time to save the digital video on your PC's hard disk.

and editing, a preview window is provided via video inlay, a technique that utilizes GDI rather than the faster DirectX to update the screen.

The system's sluggish response became frustrating during editing, and we frequently found ourselves looking at the NTSC monitor that was connected directly to the board rather than waiting for the video to appear on our PC's monitor.

On our nonlinear editing tests, the AV Master captured approximately 4.3 MBps, which was easily streamed back out to tape. The AV Master produced crisp detail, but dark and flat surfaces were

slightly noisier than in the original. The AV Master captured an impressive 2.2 MBps in our 30 fps, 320-by-240 capture tests, although on the Cinepak compression tests the results were slightly grainy, with random pink and red tinges. On our MPEG compression tests, the AV Master matched the abilities of Truevision's Bravado 1000 as best in its class with artifact-free video, clear backgrounds, and crisp details.

All in all, the AV Master performed well across a range of applications. Though not the most responsive product during editing, the AV Master would be helpful in any editing studio.

AV Master. List price: \$1,099. Requires: 16MB RAM, 20MB hard disk space, PCI slot, Microsoft Windows 95. Fast Multimedia Inc., Foster City, CA; 415-295-3500; fax, 415-345-3447; www.2fast4u.com. Circle 430 on reader service card.

MIROVIDEO DC30

The \$999 miroVideo DC30, from miro Computer Products, exhibited the highest data rate of

PERFORMANCE TESTS

Video Capture Cards



Each of these boards had its high and low points. Despite its lower throughput rates, the Truevision Bravado 1000 led the pack on our Nonlinear Editing tests with output that was crisp, bright, and noise-free. On our Cinepak and MPEG tests, the miroVideo DC30 earned the best ratings across the board; at 5.1 MBps, it also had the highest capture rate. The Digital Video Arts WakeBoard Multimedia Pro scored poorly across the board.

We tested nonlinear editing with a 3-minute BetaSP video segment made up of six separate clips. We captured at 60 fields per second and at each board's highest resolution: 640-by-480 for the AV Master and Bravado, 608-by-456 for the miroVideo DC30, and 320-by-480 for the WakeBoard.

We started capture at each board's rated bandwidth capacity, dropping the data rate by 100 KBps until the board dropped 10 frames or fewer. We then attempted to write the video segment

back out to Hi-8 videotape format. If the board dropped a number of significant frames when writing to tape, we dropped the data rate by 100 KBps. In addition, we rated each board from 1 to 4 (worst to best), based on the quality of playback and the number of frames captured.

We used three separate clips: a talking-head shot from a Hi-8 deck, the same talking head from a BetaSP deck, and a 30-second action sequence; we report the highest capture and output rates each product achieved. We compressed each clip with Xing Technologies' Software MPEG Encoder and Radius's Cinepak codec. For our subjective ratings, we compared each clip against the others, focusing on both still-frame and real-time-playback quality.

We used a 200-MHz Pentium PC with 32MB of RAM, connected to a 4GB RaidTec FlexArray FX SCSI RAID subsystem.

	Nonlinear Editing		Subjective Ratings*					
	Maximum capture rate (MBps)	Maximum output rate (MBps)	Nonlinear still frame	Nonlinear motion	Cinepak still frame	Cinepak motion	MPEG still frame	MPEG motion
Digital Video Arts WakeBoard Multimedia Pro (320 x 480)	1.7	1.0	1	1	1	1	1	1
Fast Multimedia AV Master (640 x 480)	4.3	4.3	3	3	3	3	2	4
miroVideo DC30 (608 x 456)	5.1	4.8	2	2	4	4	4	4
Truevision Bravado 1000 (640 x 480)	2.8	2.8	4	4	2	2	3	4

Higher scores represent better performance.

* On a scale from 1 to 4.



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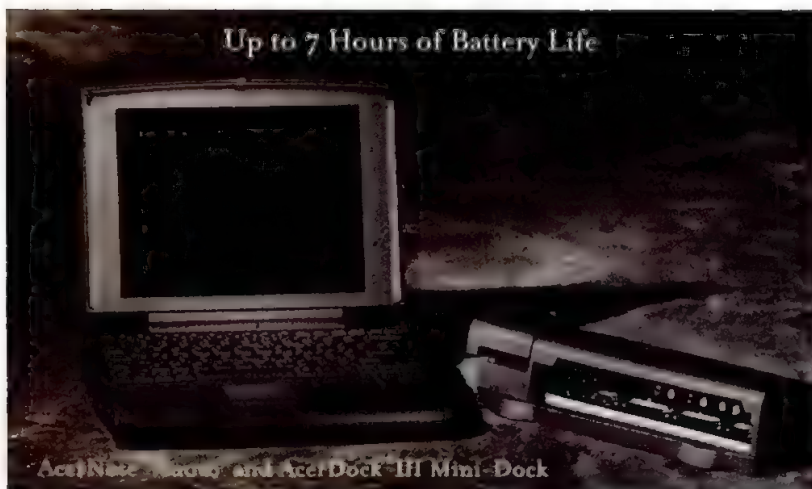
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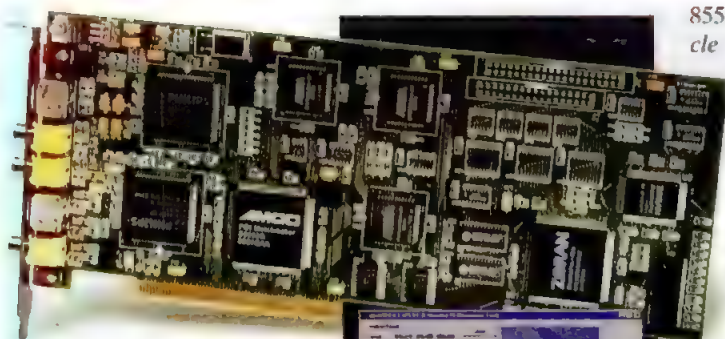


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First Looks

855-0955; www.miro.com. Circle 431 on reader service card.



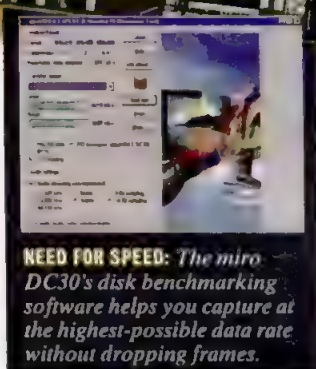
all cards tested and was the overall winner on our capture for compression tests. Though it didn't do as well on nonlinear editing tasks, the DC30 is an excellent choice for a wide variety of video capture tasks.

The DC30 is a three-quarter-length card that uses Zoran's 36050 chip for video capture and Analog Devices' SoundComm 9605 chip for 48-KHz, 16-bit stereo audio capture. In addition, on-board DSPs accelerate the display of video previews and final rendering.

miro includes a customized version of Adobe Premiere LE, Asymetrix 3D/FX, and VidCap32. The CD-ROM-based installation program was the most polished of the bunch. The DC30 captures video at 608-by-456 resolution and supports real-time video overlay via DirectX, which minimizes the need for an external NTSC monitor for capture and editing.

The board proved extremely responsive during editing, with virtually no hesitation between mouse clicks and editing actions. On the other hand, initial nonlinear editing tests were discouraging; the board captured up to 5.5 MBps but couldn't smoothly transfer this video stream to tape at even 3 MBps. Boosting system memory to 32MB and disabling write-behind cache and write-ahead optimization increased the board's bandwidth to a more acceptable 4.3 MBps.

In general, video produced by the DC30 was free of noise and artifact, and all details were well preserved. At times, colors



NEED FOR SPEED: The *miroVideo DC30's* disk benchmarking software helps you capture at the highest-possible data rate without dropping frames.

tended to be a bit washed-out compared to some of the other boards. On our 320-by-240, 30-fps capture test, capture bandwidth was limited to 1.5 MBps, compared to the AV Master's 2.2 MBps throughput. Nonetheless, the DC30 was our top performer on the MPEG and Cinepak compression tests, placing first in both moving-video and still-image-quality comparisons.

On both the Hi-8 and BetaSP capture tests, the backgrounds that the DC30 produced were clearer and more consistent than the other boards', with minimal color smearing. Talking head shots, however, were sometimes blurred by what appeared to be spatial filtering performed during capture. Action sequences had only the barest hint of blockiness.

All told, the DC30 produced great-looking video, and its instantaneous response made it a joy to use. Its ability to capture for compression tasks, and its far-from-disappointing nonlinear editing abilities make it a winner. **miroVideo DC30.** List price: \$999. Requires: 16MB RAM, 500MB hard disk space, PCI slot, Microsoft Windows 95. miro Computer Products Inc., Palo Alto, CA; 800-249-6476; 415-

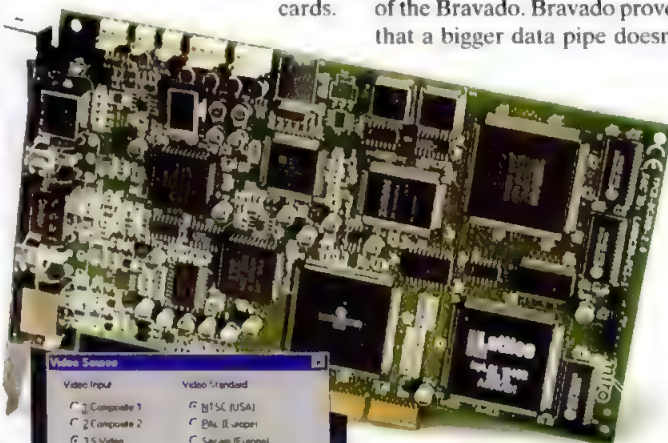
BRAVADO 1000

At \$799, Bravado was considerably cheaper than the other capture cards. It produced good video, but in data throughput it pales in comparison with the other cards.

The Bravado 1000 is a full-length card that comes with drivers for Windows 3.11, Windows 95, and Windows NT; by year's end, there should be Macintosh support, making for a clean sweep. The software offering is limited to Adobe Premiere 4.2.

Before installing the Bravado, we had to install a separate sound card, which proved to be complicated. To get our Creative Labs Sound Blaster PnP card to work, we had to remove our network adapter and change the interrupt settings manually in the Windows 95 Device Manager.

Video is previewed through GDI in the capture window, although response wasn't as immediate as it was for other cards.



CAPTURE: The Bravado's incoming-video editing controls allow you to adjust brightness, contrast, saturation, and hue before capture—which is often critical to top-quality video.

The preview stops, however, when you start to capture the video. Once captured to disk, files are displayed only on an external NTSC monitor, forcing you to edit with one eye on the computer screen and the other on the monitor. Even when working through the external monitor, the Bravado was much less responsive than the DC30 under similar circumstances.

Despite its relatively low data rate, Bravado excelled in nonlinear editing for both still-image and real-time playback. The Bravado's video had slightly less noise than other boards, with clean backgrounds, clear detail, and striking colors.

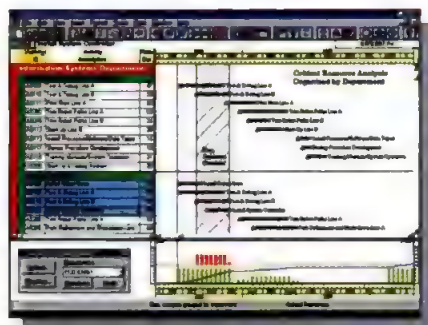
The Bravado also produced excellent compressed-video quality. When compressed with Cinepak, Bravado's video tended to be a bit grainy at times, but color fidelity was excellent. MPEG compression created some pink tinges in our Hi-8 footage but very clear BetaSP talking-head and action footage.

If you don't already own one, you need to factor the cost of an NTSC monitor into the price of the Bravado. Bravado proves that a bigger data pipe doesn't

guarantee better video quality; it produced great results in virtually all video-capture applications. **Bravado 1000.** List price: \$799. Requires: 8MB RAM, 100MB hard disk space, PCI slot, Microsoft Windows 3.1, Windows 95, or Windows NT. Truevision Inc., Santa Clara, CA; 408-562-4200; fax, 408-562-4065; www.truevision.com. Circle 432 on reader service card.

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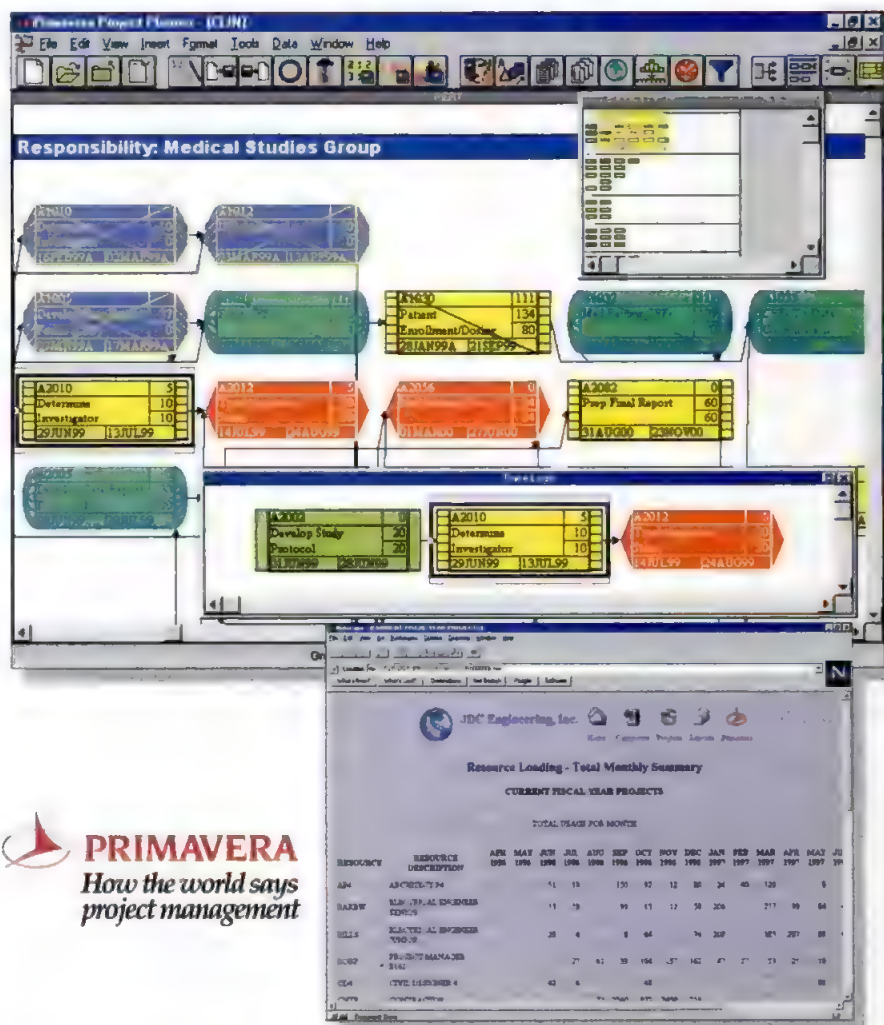
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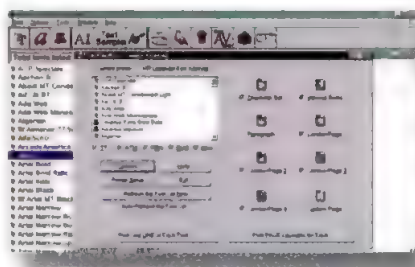
FONT MANAGEMENT

Font-0-Matic

QualiType combines a multitude of fonts with a good way to keep them straight. —By Barry Simon

The \$99 QualiType Super Value Bundle is a complete font-management solution for Microsoft Windows 95. In addition to 150 TrueType fonts, the package includes components to group fonts, install and uninstall them selectively, view samples for both installed and uninstalled fonts, print samples, and autoloading fonts that are requested by a program or document.

The package comes with versions of the software for both Windows 3.1 and Windows 95, although the Windows 95 version still contains some 16-bit code and doesn't yet support long filenames. QualiType supports TrueType fonts, and if you have



FONT CHECK: QualiType's printer sample dialog box gives you many choices for the style of the sample sheet.

Adobe's ATM installed, it also supports PostScript Type 1 fonts.

There is some overlap between QualiType and Adobe's recent release of ATM Deluxe (First Looks, October 8, 1996).

But, in general, QualiType's features are more flexible and extensive. QualiType's autoloading of fonts offers a dramatic example of the program's capabilities.

Normally when you load a document that includes a font that is on your system but not currently

installed, Windows looks for a match, displays an error message, or refuses to show the document at all. QualiType's Font Sentry, on the other hand, auto-installs the font.

And while ATM only autoloading PostScript fonts, QualiType performs its magic for both True Type and PostScript fonts. Font Sentry

can also be configured on an application-by-application basis.

In addition, QualiType's Font Handler provides eight built-in, printable sample stylesheets, including one that displays multiple

fonts as a single line—a great way to produce a font catalog. A time-saving option allows you to set up special font groupings as a tree with groups and subgroups. By contrast, ATM has only one level of groups, and you can print only one font sample per page.

QualiType also includes a program for keyboard macros and one to convert Ares Font Minder groups for Font Handler. QualiType's Lotus Screen Cam tutorials and balloons help make getting up to speed with this product a pleasure.

If you want to tame hundreds of fonts on your PC, you'll want to look closely at QualiType Super Value Bundle.

QualiType Super Value Bundle. List Price: \$99. Requires: 4MB RAM, 14MB hard disk space, Microsoft Windows 3.1 or Windows 95. QualiType Software, Southfield, MI; 800-950-2921, 313-822-2423; www.qualitype.com. Circle 404 on reader service card.

NAVIGATOR PLUG-INS

Real-Time Web Graphics

The WebXpresso plug-in lets you add interactive graphics to your Web site without writing any code. —By Jon Kaufthal

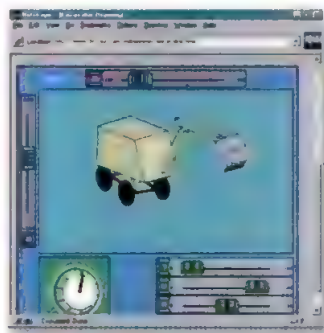
DataViews Corp.'s WebXpresso Plug-in 1.1 brings dynamic 2-D and 3-D graphics to Web pages. Available only as a Netscape Navigator plug-in, WebXpresso takes a step beyond what's possible with Macromedia's Shockwave and promotes Web graphical and dynamic interaction.

WebXpresso works as a component of DV-Xpresso, DataViews' proprietary modular development tool. The free plug-in, which is available at the company's Web site, is all you need. Unlike Shockwave and other Web graphics plug-ins, Web-Xpresso doesn't transmit traditional rasterized graphics: it sends an object-oriented, parametric model of the data to the browser. This results in



near-instantaneous feedback for the user's actions, because rather than relaying individual animation frames for every possible action, WebXpresso updates the model on the fly.

During evaluation, we set up WebXpresso to display a construction crane dynamically, letting the user move the crane around, adjust the arms, and even change its colors. We made the



LIVE DATA: The ability of WebXpresso to update information continually can help you to build an interactive animation model (above) or a live stock-quote ticker (left).

angle of perspective and the zoom factor fully adjustable as well.

Since the actual data (rather than a specific representation) is sent from the server, all of the processing is done locally once the data is received. This can be a double-edged sword: Updates don't need to query the server and have it retransmit new images, but older client PCs may seem slow.

WebXpresso is a versatile tool,

well-suited to a variety of tasks. The plug-in can receive data from nearly any source (such as a database or another Web site) and quickly generate a visual model. DataViews' samples page (www.dvcorp.com/webxpresso/samples.html) shows off some possibilities. For example, there's a live stock quote chart that continually brings in data. And there's a visual model of a baseball game that can be updated for each play.

There are two catches to all this: First, WebXpresso is a Navigator plug-in only, though the company has ActiveX and Java versions in the works. And you have to use DV-Xpresso, DataViews' powerful but clunky editor, to create content.

WebXpresso is your key to dynamic Web graphics.

WebXpresso Plug-in 1.1. List price: Free. Requires: 8MB RAM, 1MB hard disk space, Microsoft Windows 95 or Windows NT, or Unix. DataViews Corp., Northampton, MA; 800-732-3200; 413-586-4144; www.dvcorp.com/webxpresso. Circle 403 on reader service card.

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MANAGEMENT AND UNIVERSAL MAILBOX. }

INTRANETS

Intranet in a Bottle

Intranet Genie is a full-featured starter kit for building intranets, but does it work magic? —By Todd Spangler

Frontier Technologies' Intranet Genie 1.1—a collection of Internet server and client software for sharing information on internal networks—is easy to use, but setting up and configuring the gaggle of servers can

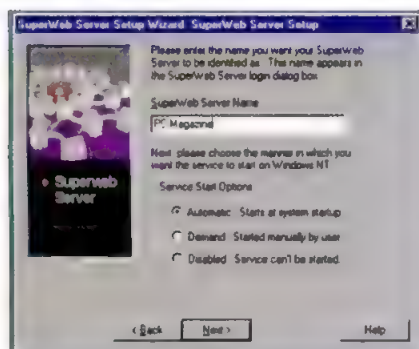
On the server end, Intranet Genie includes Frontier Technologies' SuperWeb server, a POP3 mail server, a news server, a Domain Name Service (DNS) server, and the CyberSearch server, which indexes documents and

Web pages on your LAN. The product does not include a firewall component. You can buy Intranet Genie with an optional CyberJunction (\$3,495 for all the servers, plus \$650 for ten users), for use with NetWare networks. The server software runs on Microsoft Windows NT Server 3.51 or 4.0.

By default, Intranet Genie installs all these services then launches configuration wizards. You can also select which services you want to install; only the SuperWeb server is required. The steps are simple enough, but you'll need to be familiar with DNS, Web servers, and POP3 mail.

Unlike such traditional groupware as Notes, Exchange, or Novell's GroupWise, Intranet Genie lacks a built-in central directory service, server-to-server replication, and client-to-server replication. In a future release, Intranet Genie will include a directory based on LDAP (Lightweight Directory Access Protocol).

Intranet Genie supports SSL (Secure Sockets Layer) 2.0 for encrypting communications between browsers and Web servers. The e-mail client has built-in S/MIME encryption and digital signature capability. Intranet Genie includes a few back-end applications, including a forms program and a phone list.



SUPER SUITE: Intranet Genie installs a slew of client software whether or not you intend to use it (above). The program's wizards help you set up servers, but you still need knowledge of Internet protocols (top).

confuse those unfamiliar with Internet protocols and services. Intranet Genie sells for \$2,495 for the server software, plus \$450 for a ten-user license, which is pricey when compared with traditional groupware products but less expensive than Netscape's SuiteSpot servers.

Similar to other intranet products, Intranet Genie is long on simplicity but short on powerful back-end services. For less money, products such as Lotus Notes and Microsoft Exchange give you much more powerful systems for collaborative applications (as discussed in "Reaching for the Net," October 8, 1996).

Intranet Genie installs all the components whether you need them or not. The client consists of the company's Tapestry browser, and e-mail and newsreader programs. The product also includes the CyberSearch client, a separate application that lets you easily organize and search Web sites and internal networks.

Adding users and groups is easy, and the administrator can define access rights to the SuperWeb server based on a user, group, or IP address. The package includes WebDesigner, a WYSIWYG HTML editor, an image map editor, a URL link checker, and NET Transit, an HTML conversion utility from InfoAccess. Creating and saving

Web documents, though, is still more difficult than using the native document-editing tools found in Notes or Exchange.

Overall, traditional e-mail or groupware packages are still less expensive, easier to manage, and more powerful. But if you're committed to the intranet concept, Intranet Genie offers a complete suite of Internet tools.

Intranet Genie 1.1. List price: \$2,495, plus \$450 for 10-user license. Requires: Microsoft Windows 95 (client) and Windows NT 3.51 or 4.0 (server). Frontier Technologies Corp., Mequon, WI; 800-929-3054, 414-241-4555; www.frontiernet.com. Circle 405 on reader service card.

INTERNET SOFTWARE

The Telnet Connection

This pair of telnet clients offers a host of powerful features likely to meet all your needs. —By Edward Mendelson

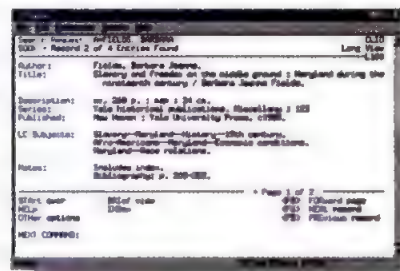
CRT 1.12, a \$30 telnet client from VanDyke Technologies, supports Zmodem file transfers and hides many useful options behind its straightforward interface. In contrast, InterSoft's \$20 NetTerm, which supports both Kermit and Zmodem transfers, is more elaborate but harder to manage, and so it may appeal more to corporate users.

CRT allows you to store different connection settings by descriptive names and specify different fonts, screen sizes, scrolling behaviors, and dozens of other options for each. Conveniently, all dialog boxes for advanced settings stay out of your way until you need them.

The program includes VT100, VT102, VT220, and ANSI terminal emulations, complete with ANSI color. A simple fill-in-the-blanks dialog box lets you automate all your log-on routines without writing separate script files. CRT is also good for sending individual screens to the printer or saving a session to disk.

The heavy-duty NetTerm

client, which includes a dialer as well as standard Internet support, lets you create elaborate log-on scripts, and when you right-click on an Internet address, the program automatically opens the address in your Web browser. The program also integrates closely with remote Unix systems. NetTerm lets you edit a remote file on



FLEXIBLE: CRT adapts to remote Unix systems by optionally displaying color where Unix uses a boldfaced screen font.

your computer and then send it back to the remote site.

Trial versions are available from www.vandyke.com (CRT) and starbase.neosoft.com/~zkr01 (NetTerm). CRT balances powerful features with a simple interface; NetTerm is all business. Both are bargains.

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Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

By Brian Nadel

INTEGRATED SOFTWARE

ClarisWorks: Easier on the Eyes

WHEN WE FIRST REVIEWED ClarisWorks 4.0 (First Looks, March 26, 1996), we were impressed with this integrated application's ability to pack much of the power and many of the features of a full-fledged suite into just 12MB of your system's hard disk. What we didn't know at the time was that if you used Diamond Multimedia's Stealth-64 graphics adapter, you might have trouble reading what you were working on.

The reason? When paired with the Stealth64 card, Claris-

Works 4.0 often displays text as black characters on a black background—hardly the optimal design for viewing and editing text. Switching to the generic Microsoft Windows 95 driver straightens out the black-on-black problem, but the excessive monitor flicker that results could make you feel queasy.

The best solution is to use the most recent Diamond drivers, which are available as free downloads from the company. Unfortunately, finding the correct driver can be confusing, because



there are three drivers in question. We recommend you try them in this order: Version 4.02.325 of the Stealth64 Video 3000 driver; Version 4.02.373 (beta) of the SpeedStar64 driver; and the alpha version of the GT95325b driver. The first two

are available at Diamond's Web site (www.diamondmm.com), and the third can be downloaded from the company's FTP site (<ftp://ftp.diamondmm.com/pub/display/stealth/gtalpha/gt95325b.exe>).

This three-step process can be disconcerting, but chances are that one of these drivers will work and solve this problem, as well as other screen-related ClarisWorks glitches.

VIDEO CAPTURE

Broadway Video's Encore

IN OUR INITIAL REVIEW OF DATA TRANSLATION'S TWO-PASS MPEG encoding system, Broadway, we liked the card's speed as well as its ability to work with a variety of high-end PC editing programs (First Looks, September 24, 1996). What we didn't like was the general softness of the 352- by 240-pixel video streams it produced.

The image softness was caused by the board's C-Cube MPEG chip during capture. Though filtering did help to improve video from low-quality sources, it reduced the sharpness of video images

from better sources, bringing it all down to roughly the same image quality. At the time of our review, the program did not allow users to disable the filtering when importing video from high-quality sources.

In a quick about-face, Data Translation engineers

have made filtering an option that can be turned on or off, depending on the video editor's preference. The result is that you can work with filtering for VHS-based material but do without it for higher-quality video formats, such as digital Beta CAM.

This software upgrade is available from Data Translation at the company's Web site (www.b-way.com). During side-by-side testing, you can really see the edge sharpness of a clip degrade when filtering is turned on. It's your choice.

While you're at the Data Translation Web site, check out the newly released drivers for Microsoft Windows NT. They include support for producing material in Video CD format.

UTILITIES

A Quicker View Of Your Data

INSO'S QUICKVIEW PLUS ("The Ultimate Utility Guide," May 14, 1996) is an excellent file-viewing utility that can do double duty as a Netscape Navigator Plug-In and helper application for use with your Web browser. The only problem with this Editors' Choice-winning program was that it wasn't compatible with some versions of Navigator. The most common problems include fatal exception errors and system crashes.

The quick fix is to download and install the QVPMIME file from Inso's Web site (www.inso.com). Follow the detailed set of instructions during installation—but be careful, because there are separate programs available for 16- and 32-bit operating environments.

Once you've installed the update, QuickView should get along nicely with your Web browser.

BUG BRIEFS

PROBLEM

The installation of Email Connection 3.0 can interfere with a loaded ODBC driver, which halts the configuration process on the first screen.

SOLUTION

Remove all statements about Microsoft Office and the Visioneer PaperPort from the WIN.INI and SYSTEM.INI files, restart your PC, and reinstall the program.

PROBLEM

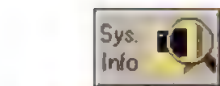
When we reviewed Minolta's RD-175 professional digital camera, the system lacked Twain acquisition drivers for Windows 95.

SOLUTION

The latest drivers for the RD-175 support Microsoft Windows 95 and can be downloaded from the Minolta Web site (www.minoltausa.com). Or you can call 201-236-4218.

SECOND LOOKS MAILBOX: Tell Second Looks about your experiences with computer products. Contact Brian Nadel via MCI Mail (556-1500), CompuServe (72241,1616), or the Internet (bnadel@zd.com).

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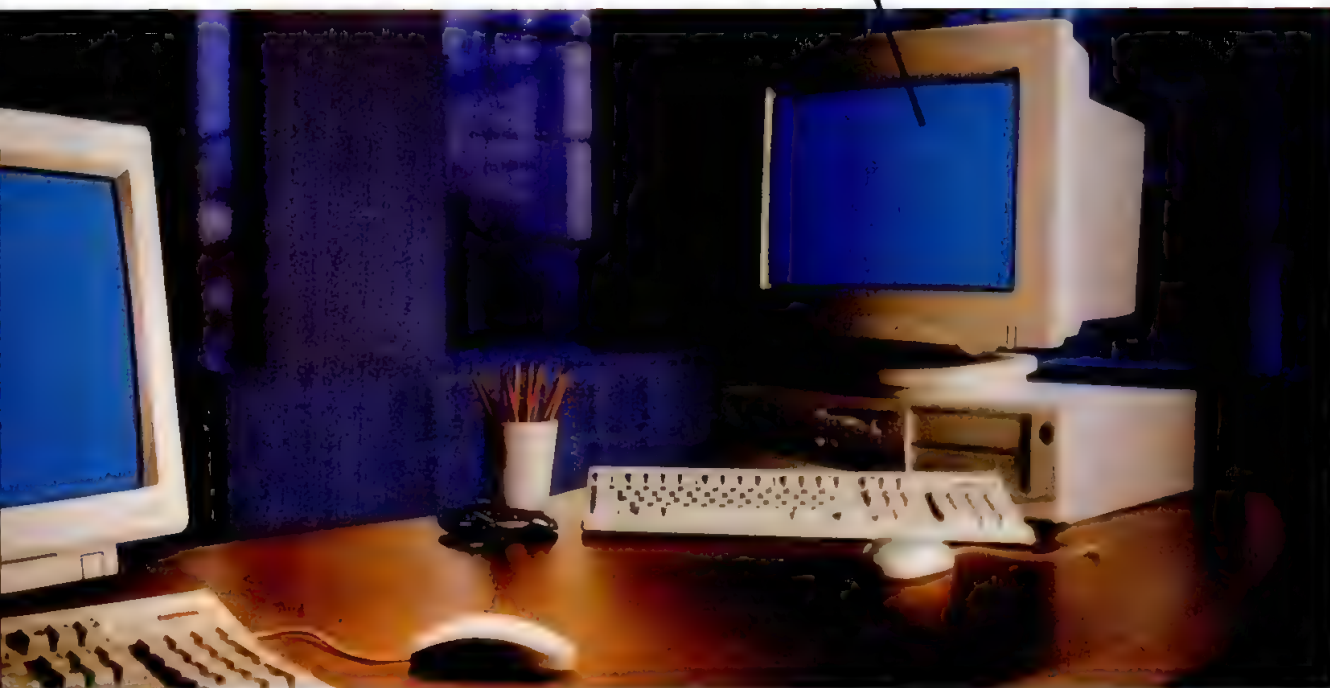
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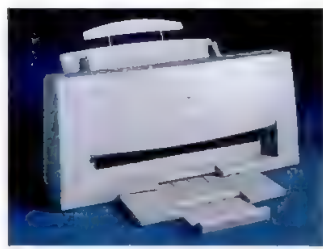
New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

Large, Small, And Colorful

IN ADDITION TO THE COLOR ink jet printers reviewed in this issue's feature story, "Personal Printers Showdown," Canon



Computer Systems has two printers that were not released in time to be included in that roundup.

The \$400 **Canon BJC-620** is targeted at home and small-office markets that require near-photographic quality printing. With double the print speed of earlier

models, the BJC-620 engine generates 3 pages per minute (ppm) of black text and 1.7 ppm of color content. Print resolution is at 720 by 360 dots per inch (dpi). The BJC-620's individual ink tank system lets you replace only the color (cyan, magenta, yellow, or black) that is needed.

The **Canon BJC-4550** breaks new ground by offering a wide-format, color, dual-platform printer for just \$500. The printer, whose resolution is 720 by 360 dpi, supports paper of up to 11 by 17 inches. The print engine prints black pages at 5 ppm and color at 1 ppm. The printer also supports Canon's optional Photo and Neon Ink cartridges.

Both of these units can print across a wide variety of media. **Canon Computer Systems Inc.**, Costa Mesa, CA; 800-848-4123; www.ccsi.canon.com. *Circle 409 on reader service card.*

Just Imagine

NUMBER NINE VISUAL TECHNOLOGY's flagship graphics accelerator card, the Imagine 128 Series 2, is available in a lower-cost version.

The \$400 **Imagine 128 Series 2e** provides 128-bit 2-D and 3-D graphics acceleration and software-based MPEG decoding for fully-scalable, full-screen movie-

quality video (of up to 1024-by-768 at 16.8 million colors). The Series 2e comes with 4MB of VRAM.

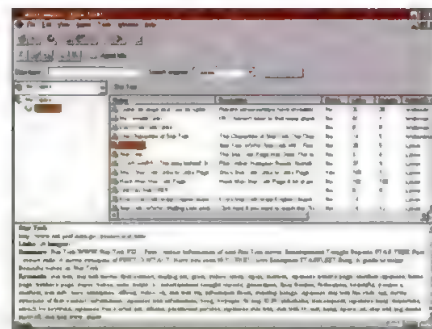
Designed for use with 32-bit systems, the card features support for OpenGL 3-D applications for workstation-level 3-D rendering. **Number Nine Visual Technology**, Lexington MA; 800-438-6463, 617-674-0009; www.nine.com. *Circle 410 on reader service card.*



Customized Internet Searches

UNLIKE SYMANTEC'S INTERNET FASTFIND, WHICH OFFERS A suite of Internet productivity tools (see Hot Prospect), Quarterdeck's \$50 **WebCompass Professional, Version 2.0** focuses strictly on delivering search results.

WebCompass provides customized filtering fields for conducting specific and highly tailored searches across multiple Internet search engines; you can also search across FTP, gopher, and Usenet sites. Search matches are



merged onto a single page and displayed with their URLs and the content abstracts that are generated by statistical and natural-language querying techniques. The Windows 95 Explorer-style interface makes it easy for you to store results in folders according to subject, move results between folders, publish results to HTML, and add personal notes. A query wizard further simplifies searching for novice users. **Quarterdeck Corp.**, Marina del Rey, CA; 800-282-0866, 310-309-3700; www.quarterdeck.com. *Circle 407 on reader service card.*

HOT PROSPECT

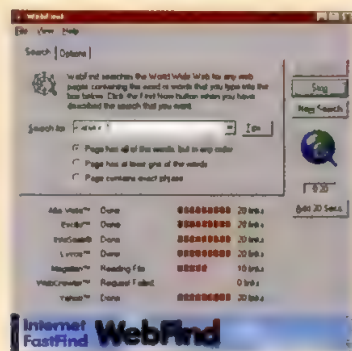
Searching the Internet in Style

The proliferation of Internet search engines, coupled with astronomical growth of the Web, makes it more difficult than ever to find the specific information you're looking for. Symantec's \$49.95 **Internet FastFind** for Windows 95 or Windows NT offers a terrific combination of Internet search utilities and tools. **WebFind** provides a single interface for searching multiple search engines. It merges and collates results and displays them in a single list along with descriptions of the sites. You can sort the results by page or by site, and you can mark pages so you'll be notified when they change.

Among the other included tools is **EasyFTP**. The same FTP utility that's included in Norton Navigator, the drag-and-drop interface treats FTP sites as

though they were being displayed in Windows 95 Explorer. Also handy is **WebLaunch**, which merges bookmarks across multiple Web browsers and makes them accessible from the taskbar, and **Net-FileFind** for searching for specific files on the Internet.

Symantec Corp., Cupertino, CA; 800-441-7234, 541-334-6054; www.symantec.com. *Circle 406 on reader service card.*



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Knight-Ridder Information, Mountain View, CA. 800-334-2564, 415-254-8800; www.krinfo.com. *Circle 408 on reader service card.*

Transform Your Images

SPANNING THE SPECTRUM OF BOTH NOVICE AND ADVANCED users of image-editing software is JASC's **Paint Shop Pro 4.0**. Now a full 32-bit application, this powerful \$69 tool a wide breadth of Internet support, including the ability to adjust overall opacity, designate a transparent color, or feather a selected area to create what appears to be a smooth edge.

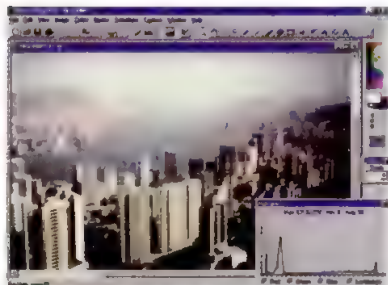


PHOTO FINISH: Paint Shop Pro 4.0

templates for creating greeting cards, calendars, flyers, and more. For novices, there's the \$24.99 **MGI PC PhotoStarter Kit**, a scaled-down version of PhotoSuite that, among other things, lacks Twain support.

JASC Inc., Eden Prairie, MN; 800-622-2793, 612-930-9800; www.jasc.com. *Circle 414 on reader service card.*

MGI Software Corp., Richmond Hill, Ontario, Canada; 905-764-7000; www.mgisoft.com. *Circle 415 on reader service card.*

Personal Agent

DO YOU HAVE AN ARTICLE you want to publish professionally? Datafox Software's \$48.50 **Writer's Agent** has a searchable database of over 2,000 publishers. It includes profiles, contact information, and compensation policies, and it generates and tracks submission letters.

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with the 1997 **Writer's Market—The Electronic Edition**. The \$39.99 disk has a searchable database of 4,000 publications, a copy of *Writer's Encyclopedia*, Third Edition, and a program for tracking submissions and payments.

Datafox Software, New York; 800-328-2369; 212-307-1710; www.datafox.com. *Circle 416 on reader service card.*

Writer's Digest Books, Cincinnati, OH; 800-289-0963, 513-531-2222; fax, 513-531-4744. *Circle 417 on reader service card.*

Photo Scanners Extraordinaire

SOME PHOTOGRAPHERS PREFER SHOOTING SLIDES; OTHERS prefer print film. Here's a selection of photo scanners for both groups.

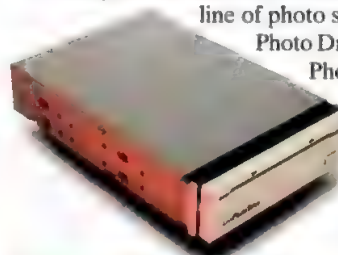
For high-end, dedicated 35-mm slide and negative scanning, Polaroid Corp.'s now has the \$2,295 **SprintScan 35 Plus**. The Twain-compliant, single-pass scanner has an optical resolution of 2,700 dpi. You can scan images at 12-bit RGB color in under a minute; the optical density range is a strong 0 to 3.4. Catering to the midrange market, the **SprintScan 35/LE** is just \$1,295. The two scanners' specs differ only in the that the SprintScan 35/LE has optical resolution of 1,950 dpi, scanned at 10-bit RGB color with a density of 0 to 3.0.



SPEEDY SCANS: Polaroid's SprintScan 35/LE.

Microtek Lab's \$799 **ScanMaker 35t** has specs which are similar to those of the SprintScan 35/LE. This single-pass scanner has a dynamic range of 0 to 3.1 and a high optical resolution of 1,950 dpi. The Twain-compliant scanner is bundled with Ulead's PhotoImpact SE image editor.

For snapshot lovers, Storm Technology adds the **EasyPhoto Drive** to its line of photo scanners. Priced at \$199, the EasyPhoto Drive is the commercial version of the Photo Drive found in the HP Pavilion



SCANNER AT BAY: EasyPhoto Drive.

home PCs. Designed to fit in a 5.25-inch drive bay, the scanner has an easy-to-install jumperless interface card, and it can slide out for accessing and cleaning the scan surface. The scanner has a 400-dpi optical resolution and accommodates photos of to 4-by-6-

inches. Bundled with the scanner is Storm's newly upgraded EasyPhoto 2.5, a 32-bit image editor.

Polaroid Corp. Technology, Cambridge, MA; 800-816-2611, ext. 971; www.polaroid.com. *Circle 411 on reader service card.*

Microtek Lab Inc., Redondo Beach, CA; 800-654-4160, 310-297-5000; www.microtekusa.com. *Circle 412 on reader service card.*

Storm Technology, Sunnyvale, CA; 888-438-3279, 408-522-1200; www.easypphoto.com. *Circle 413 on reader service card.*

BRIEFS

Books

So you've finally got a fast, multimedia-ready PC at home; now what do you do with it? **The Family PC Guide** is a new series that gives you information on software to buy, cool PC projects, and ways your kids can use the computer as a homework helper (\$24.95 each, Hyperion, 800-759-0190) There's no place like... the Web? **Home Sweet Home Page** is a concise, well-illustrated guide for families who want to get on the Web (\$14.95, Peachpit Press, 800-283-9444) With the release of its Web-savvy Version 7, the WordPerfect

suite is regaining ground. **The Official Guide to Corel WordPerfect 7** shows you all of the product's new Internet features (\$34.99 Osborne/McGraw-Hill, 800-227-0900).

Hardware

Graphic Utilities' ecologically minded \$13.81 **InkLink** is a no-mess ink-feed system that lets you easily provide a continuous ink supply to HP DeskJet 500 series printer cartridges without opening or refilling the ink cartridge (408-577-0334) Philips Electronics' \$295 **EasyISDN** terminal adapter 128

provides a synchronous Multilink PPP connection for a 128-Kbps data rate, an integrated network terminator, automatic ISDN switch and line-type detection, and two analog ports (800-235-7373) Belkin Components' \$109 parallel device **ParaShare 95** offers networking for small offices, making it easy for two or more computers to share a printer, fax modem, CD-ROM, e-mail, and more (310-898-1100) Panasonic's 17-inch \$730 **PanaMedia** monitor provides 3-watt Dome Speakers and a 0.27-mm dot pitch (800-726-2797).



August 1998
PC Magazine
Editors' Choice
WinBook XPS P100

Best Pentium processor-based PC at entry-level price.

- Intel 75 or 100 MHz Pentium processor
- 8-16MB RAM, expandable to 128MB
- EDO RAM
- Optional 256KB cache
- 640MB** high-performance Enhanced-IDE hard drive
- PCI integrated graphics accelerator and 1MB DRAM standard, upgradable to 2MB
- Flash BIOS for easy upgrade
- Designed for Windows® 95
- Preloaded HP DMI Desktop Management Interface
- Free three-year limited warranty for parts and labor¹

from **\$1,262***



HP Vectra VE

Best managed PC.

- Intel 75, 100, 120, 133, 150 or 166 MHz Pentium processor
- LAN Remote Power
- PCI integrated 32-bit 10Base-T Ethernet interface
- Network certified and preconfigured for Microsoft® and Novell clients
- Preloaded HP DMI Desktop Management Interface
- Vectra Op-Center
- Norton Smart Disk Doctor
- Parallel transfer driver preinstalled for faster LAN packet processing
- Advanced security meeting C2 level
- 64-bit graphics accelerator on PCI bus
- 1MB video RAM, expandable to 2MB
- 8 or 16MB EDO RAM, expandable to 128MB
- 840 or 1280MB Enhanced-IDE hard drive
- 4 mass storage shelves (3 front accessible), 4 expansion slots
- Two 32-bit PCI slots
- Flash BIOS for easy upgrade
- Designed for Windows 95
- Free three-year limited warranty for parts and labor¹

from **\$1,513***



HP Vectra XM

Leading Pentium processor/PCI performance at an affordable price.

- Intel 100, 120, 133, 150 or 166 MHz Pentium processor
- Desktop and minitower packages
- 256KB burst synchronous cache
- 8-16MB RAM, expandable to 128MB
- EDO RAM
- PCI/ISA architecture
- 640MB** high-performance Enhanced-IDE hard drive
- PCI integrated graphics accelerator and 1MB DRAM standard, upgradable to 2MB or Matrox Millennium PCI graphics card with 3D acceleration and 2MB WRAM, upgradable to 8MB
- Flash BIOS for easy upgrade
- Full plug-and-play capability
- Designed for Windows 95
- Preloaded HP DMI Desktop Management Interface
- Free three-year limited warranty for parts and labor¹

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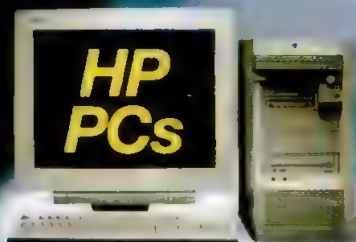
HP Vectra VL

**Exceptional performance
and expandability at an
affordable price.**

The ultimate PC.

- Intel Pentium Pro 150, 180 or 200 MHz processor with 256KB integrated cache
- Supports dual processing with secondary Pentium Pro socket
- 128-bit high-performance memory architecture
- 16-32MB ECC DIMM memory standard, expandable to 256MB with 8 DIMM memory expansion slots
- PCI integrated Ultra SCSI Fast 20 interface with 20MB/s throughput
- 1,000MB** SCSI-2 high-performance hard drive
- PCI Matrox Millennium graphics card with 3D acceleration and 2MB WRAM, upgradable to 4MB or 8MB
- 7 mass storage shelves (5 front accessible)
- 6 expansion slots: 3 PCI, 1 PCI/ISA combo and 2 ISA
- 10Base-T/100VG AnyLAN selectable PCI NIC with up to 100 Mb/s throughput
- Integrated 16-bit audio and 4X CD-ROM
- Microsoft Windows NT® 3.51
- Free three-year limited warranty for parts and labor

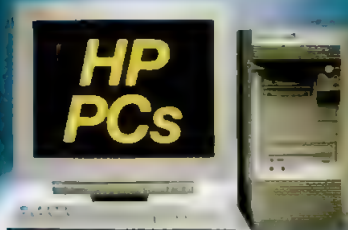
from **\$3,939***



HP Vectra XU

- Intel Pentium Pro 150 MHz processor with 256KB integrated cache
- 128-bit high-performance memory architecture
- 16MB DIMM memory standard, expandable to 256MB with 8 DIMM memory expansion sockets
- 1,000MB** Enhanced-IDE hard drive
- PCI Matrox Millennium graphics card with 3D acceleration and 2MB WRAM, upgradable to 4MB or 8MB
- 7 mass storage shelves (5 front accessible)
- 6 expansion slots: 3 PCI, 1 PCI/ISA combo and 2 ISA
- Integrated 16-bit audio and 4X CD-ROM
- Microsoft Windows NT 3.51 or IBM OS/2® Warp
- Free three-year limited warranty for parts and labor

from **\$2,615***



HP Vectra VT

Helpful hint:

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A little comparison shopping will quickly show you that HP puts the best prices on the most impressive PCs. One standout is the network-ready Vectra XM. It's configured for the most demanding networks with LAN Remote Power, Super-fast LAN install and HP Vectra Op-Center for more effective remote management. Every Vectra will outshine the competition when it comes to features and price. From the Pentium® processor-based PCs to the dual Pentium Pro processor-based HP Vectra XU PC. For more information or the name of your nearest HP reseller, call 1-800-322-HPPC, Ext. 1703! Or visit us at <http://www.hp.com/go/vectra>.

A PIM for Every Purpose

NO MATTER WHAT YOUR NEEDS, ODDS ARE THERE'S A PERSONAL information manager out there for you, now linked to the Internet.

Power users can appreciate GoldMine Software Corp.'s **GoldMine 3.2 for Windows 95 and Windows NT 4.0**, an Editors' Choice winner ("Good-Bye, Rolodex! So Long, Sticky Notes!" April 23, 1996). The \$295 workgroup-enabled package has added a laundry list of new features, including support for Internet e-mail and database synchronization via the Internet, the ability to import data from a Web page directly into GoldMine, spell-checking, and graphical organizational charts.

Day-Timer Technologies' \$59.95 **Day-Timer Organizer 2.1** adds several enhancements over the previous version, including improved custom-printing options. Most notable is that the contact records' Web and e-mail addresses now launch your e-mail software and Web browser.

For a less complex approach, try Individual Software Corp.'s \$49.95 **AnyTime Deluxe**. A flexible package, AnyTime includes a scheduler, address book, and to-do list. New to this version are a notepad, MAPI-compliant e-mail, and a layout creator for customized printouts.

Janna Systems' \$49 **Janna Contact Personal** provides access to contact information and related documents, faxes, multimedia files, and appointments. Included is a Microsoft Word macro for inserting contact info into a Word document and a link to Caller ID phone service. Internet-enabled, Contact Personal lets you store Web site shortcuts and send e-mail from within the program.

GoldMine Software Corp., Pacific Palisades, CA; 800-654-3526, 310-454-6800; www.goldminesw.com. Circle 418 on reader service card.

Day-Timer Technologies, San Mateo, CA; 800-225-5005, 415-572-6260; www.daytimer.com. Circle 419 on reader service card.

Individual Software Inc., Pleasanton, CA; 800-822-3522, 510-734-6767; www.individualsoftware.com. Circle 420 on reader service card.

Janna Systems, Los Gatos, CA; 800-268-6107, 408-356-6647; www.janna.com. Circle 433 on reader service card.

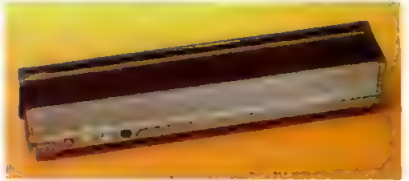
Point and Print

CAPITALIZING ON THE infrared ports that are now standard on notebook computers is Citizen America Corp.'s \$499 **PN60i Portable Printer**.

Weighing in at just 1 pound, the compact PN60i features a built-in IrDA interface for cableless printing. The printer prints at up to 2 ppm using Citizen's Thermal Fusion print technology, which can accommo-

date a variety of paper stocks. To facilitate printing as well as IR file transfers, Citizen bundles Puma Technology's TranXit software with the printer.

Citizen America Corp., Santa Monica, CA; 310-453-0614; fax, 310-453-2814; www.citizen-america.com. Circle 422 on reader service card.



Revolutionary PC Design

THE ELEGANT DESIGN OF COMPAQ COMPUTER CORP.'S innovative **Compaq Presario 3020** doesn't sacrifice power or functionality.

The \$3,499 system's sleek, rectangular shape follows the contours of the 12.1-inch double-bright active-matrix LCD panel and pair of JBL Pro speakers, a welcome departure from the usual bulky design you'd



expect to see. Thoughtfully integrated into this casing is the PC itself, which includes: a Pentium/166 CPU; 24MB of EDO RAM; a 2GB hard disk; 2MB of EDO VRAM; a 6X, four-disk, auto-load CD-ROM changer; 16-bit Spatializer 3-D sound; a cordless mouse; a 33.6-Kbps Talk and Send DSVD modem; a full-duplex speakerphone; and a multi-functional telephone answering system.

Future expansion is enabled via two PCI and two ISA slots, as well as two USB connectors. The system also features Compaq's convenient button pad for easy access to the CD-ROM and more.

Compaq Computer Corp., Houston; 800-345-1518; www.compaq.com. Circle 423 on reader service card.

BRIEFS

Software

Imaging International's \$129.95 **WORDfind Personal Edition** will help you cut through the potpourri of data files on your hard disk by creating an index that you can locate later by searching on words or phrases in the text (800-566-8085) Kaplan Educational Center has both graduate students and undergraduate students in mind with its **RoadTrip** series for the SAT/ACT and the GRE/GMAT/LSAT. Priced at \$29.95 apiece, these CD-ROMs help students prepare for standardized exams (212-492-

5800) Innovative Quality Software is offering a 40 percent savings on its powerful suite of hard disk-based audio editing tools. The **SAW (Software Audio Workshop) Classic** is now priced at \$299 (702-435-9077) Create storyboards for your multimedia projects from within Microsoft Word using Morley & Associates' \$89 **Morley's Templates for Multimedia** (800-484-7511) DeLorme Mapping has updated its \$29 **Phone Search USA** software to Version 2.0 (207-865-1234) Make the connection between a record in your contact

database and the documents related to it with Data Fellows' \$295 groupware package, **Vineyard 2.1**. This version adds extended scripting languages and Microsoft Visual Basic compatibility (408-244-9090).

Internet

Get the most out of Netscape Navigator 3.0 with Individual Software's \$19.95 **Learn Netscape Navigator Quick & Easy**. This CD-ROM provides you with starter-kit Internet access via EarthLink Network (800-822-3522).

COMPUTER DISCOUNT WAREHOUSE

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CDW®, one of the nation's leading direct marketers of microcomputer products to businesses, Microsoft, and American Express have teamed up to bring you a very special, limited time offer: Purchase any brand-name computer and \$50 in Microsoft software from CDW, charge it on your American Express Card, and receive a \$50 CDW Instant Rebate.

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(Actual size)

Figure

File Edit View Help



9:52 AM

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800 x 600, the 700 Series notebooks are the

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For power, performance and value, choose one of the 700 Series notebooks from CTX.

Nothing else quite measures

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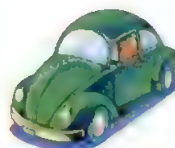
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Web Power Tools: The Cutting Edge?

It's the same old story. The pioneers do it the hard way, and the newcomers use power tools. Two years ago, or whenever the good old days of Web site building were, if you wanted to create a site you used a text editor and did HTML coding by hand. You

could rattle off the tags in your sleep, and you knew all the tricks. You were practicing a craft, and the best sites shone with the craftsmanship of their creators, much as a hand-carved wooden sculpture does.

Last year we had the equivalent of the steam drill—add-ons to word processors that could turn boldfacing, variable font sizing, and other formatting into HTML tags. But like the steam drill, these add-ons were clunky and obstreperous, and the more determined among HTML coders could do better with just their own unsophisticated text editors. I refer to the add-ons in the past tense because I can't imagine why someone would use one, other than from habit.

Now we have site-building programs, the bulk of which were amply reviewed in *PC Magazine's* cover story "Build Your Own Web Site" (September 10, 1996). And instead of a steam drill, we have a variety of semispecialized tools, each with its own strengths and weaknesses.

Over the past couple of weeks, I've spent a considerable amount of time with two of these tools, Microsoft's FrontPage and Asymetrix's WebPublisher. FrontPage won *PC Magazine's* Editors' Choice; WebPublisher was not on the market in time to be included in our testing. Comparing the two is instructive as to emerging differences and offers a view into the future of Web publishing software.

FrontPage is a tour de force, addressing virtually every aspect of producing a Web page. It's especially strong on the management aspects of building and maintaining a site. There's just one small problem: Aesthetically, it's a blank sheet. You can build any kind of Web site, but FrontPage won't give you a lick of help in terms of look or feel. But if you know what you're doing with HTML, and if you can harness the power of tables to create borders, multiple columns, and attractive features, it won't slow you down. You'll revel in its ability to create template pages that give your project a consistent look and feel. Templates can hold your backgrounds, headings, borders, and navigation buttons, leaving you free to concentrate on the content of each page.

But people who call FrontPage WYSIWYG or drag-and-

drop wildly overstate the case. Its Table button, for instance, is mostly useless: The tables divide the available space equally, and you can't change their borders without editing the HTML. You can import text and graphics, but you can't move them around without hand-coding the alignment and width tags.

WebPublisher is thoroughly modern, using HTML tables extensively to control the format. Instead of the "you can do anything you want from here" main screen of FrontPage, WebPublisher gives you a highly structured, step-by-step guide. You choose from over 20 predesigned graphical themes that include colors, backgrounds, borders, separators, titles, and navigation buttons. You select from four different page styles that mix graphics and text: over/under, side-by-side, wrapped, and bulleted. The difference between WebPublisher and FrontPage is like that between Print Shop Deluxe and PageMaker. WebPublisher won't give you terribly original-looking pages, but you'll get something functional fast.

If anything, though, WebPublisher is way too far into the color-and-cuteness camp to suit me and, I suspect, many other prospective Web designers. Only three of the graphical themes have white backgrounds, which most businesses will want, and one of them is adorned with teeth (an interesting dental motif). Too many of the other themes are usable only by kids, real-estate agents, or florists. Another drawback of WebPublisher is that it wants to

build sites that are only two levels deep. To make the navigation buttons work correctly with deeper hierarchies of pages, you have to modify the HTML code.

Web site tools need to go through at least one and perhaps two more stages of improvement. I would love to see a template-driven front end for FrontPage, or a configuration step in WebPublisher through which I could modify or replace the graphics with something a bit more widely usable. Still, WebPublisher has a big lead on everything else out there, with its automatic resizing of graphics and its text wrapping around images. These are exciting times for Web publishing, and the best is yet to come. □



CREATION STORY

In the past, building a Web site was a craft, much as hand-carving a wooden sculpture is.

PRESENTING A CONCEPT PREVIOUSLY

OVERLOOKED IN MONITOR DESIGN.



Finally, one monitor company has achieved the much anticipated convergence of audio and video: the media-ready series from Nokia.

Behind the sleek tooling, dual powered stereo high/midrange speakers, a deep-tuned sub-woofer waits to shape the richest audio your computer can unleash. As Europe's premiere monitor company, Nokia has created a tuning port architecture housed in the monitor's swivel base which allows complete utility plus maximum aural impact.

These systems extend Nokia's most award-winning line: the X series. Gaze into some of the most ergonomic screens in the world—including the first to meet the new

VESA standards for refresh and resolution. Their aperture grill of a mere .25 mm and lavish 15.7" viewing area make the work space simultaneously soothing and exciting. The media-ready series features the first displays to achieve the TCO'95 standard for monitor emissions.

So, if you are preparing to upgrade your monitor—or your computer's audio system—don't overlook these phenomenal displays. They offer a level of superiority you can appreciate even with your eyes closed.



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NOKIA
MONITORS

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Rude Newsgroups Run Rampant

An interesting aspect of the Internet is its unrestrained and often rude nature. There's something about genuine free speech that sometimes brings out the worst in people. Things people would never say to your face are posted, without qualms, on the Internet.

The worst example of this phenomenon is the flame—basically, an e-mail tirade directed at another user. This behavior is most apparent in the newsgroups. It's incredibly annoying how informative discussions can deteriorate into bitter rants just because of some trivial remark.

Recently, I was trying to find out which satellite dish to get: DirectTV or Dish Network. I had already scoured the Web, to no avail. The only interesting thing on the Web I could find (besides a bunch of marketing hype) was a grudge page called Primestar Sucks! that had customer-service letters posted for all to read. Anyway, I gave up on finding a Web site that would actually tell me which dish system to buy—a huge disappointment. Instead, I went on www.dejanews.com to search the newsgroups.

I searched on variations of "satellite dish" and "DBS" and found an open discussion concerned with the pros and cons of the various systems. It wasn't as technical as I'd hoped, but it did seem to indicate that the Dish Network is the hot ticket. Unfortunately, the fruitful discussion quickly degenerated into an argument over copyright infringement: Someone posted a copy of a press release about the Dish Network and someone else—who apparently doesn't understand that press releases are supposed to be passed around—complained that the posting was a violation of copyright law. Blah, blah, blah.

In response, the guy who posted the press release called the copyright complainer a "Net cop" and lit into him about one thing or another. In no time, the discussion had gone from being about people's experiences with the dishes to a rant on copyright law and the Internet. As I write this column, the newsgroup is on the verge of becoming a complete flamewest.

Anyone who has tried to extract information from newsgroups has seen the same thing happen. Discussion devolves into drivel. It doesn't take a lot of research to figure out what's going on. With Dejanews, you can click on the e-mail address of a person who posted a message and see a listing of every single posting the person has done in

every single newsgroup. It's an eye-opener. In some instances, you'll find that one guy has posted thousands and thousands of messages in hundreds of newsgroups, with an opinion on seemingly everything. This guy, who we'll call Newsgroup Charlie, has been doing nothing but online kibitzing for a decade.

There is a certain air to these messages, as though they'd been written by someone knowledgeable. Unfortunately, it's really the air of authority without any experience necessarily behind it. And guys like Newsgroup Charlie are quick to flame others. Hundreds and hundreds of Newsgroup Charlies clog the Net. These guys need to get out of the house more, let me tell you.

This whole subculture was tolerable a year or two ago, before the Web introduced tens of millions of people to the world of the Internet. But those days of Internet obscurity are over. More and more people are discovering newsgroups and other resources on the Net. The sheer volume of people who might enter a newsgroup makes flaming—and even small talk—intolerable. It will be the death of newsgroups. We've seen some aspects of this in commercial online services, where the discussion groups, which are supposed to be regulated, have simply deteriorated into "me too" messages, one-liners, useless comments, flames, insults, and slander. There is little discussion of the actual topic of the newsgroup.

In the unregulated newsgroup environment, the situation is even worse. No solution exists except civility, but too many Newsgroup Charlies make that impossible. The Charlies might be software engineers at Sun (there seems to be a slew of them holed up at Sun Microsystems, where there are still a lot of Unix command line worshippers), or unemployed wannabes who still believe that the command line is king because they cling to their old 286s, or maybe pathetic adults who wish they were still teenagers playing Dungeons & Dragons.

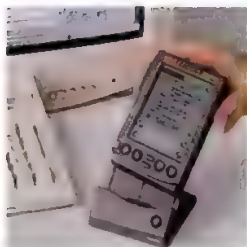
It's an online world of flotsam and jetsam, and there is nothing we can do about it. Nothing, except complain. And that's what I just did.



NEWSGROUPIES
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hundreds of
Newsgroup
Charlies are
clogging up the
Internet.



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U.S. Robotics

Inside Track

As we head into 1997, the Intel strategy regarding **MMX is still a mess**, with system vendors pressuring Intel to go slow. Current thinking is that MMX will actually come out on the Pentium Pro before it does on the Pentium. Since the pipeline is not full of Pentium Pro machines, computer makers can't complain—they believe MMX is so hot, unless it's put on the **Pentium Pro** it will kill the market for regular Pentiums.

Besides, the Pentium Pro is Intel's machine of the future anyway, and the company is not happy with **people lingering on the P5** platform. Intel has made it clear that it wants no part of the low end of the PC business. MMX-enabled Pentium Pros will help lure people to the next-generation systems faster. Intel's entire long-term strategy is based on upgrading users to newer and newer processors, especially when those processors are still expensive. This may be a way to do it.

Meanwhile, more and more talk is emerging concerning the **P7 (code-named Merced)**, the jointly designed next-generation processor from Intel and HP. This chip is expected to ship in 1998 or so but will probably be announced next year. **Two offbeat rumors have emerged** from technical newsgroups. One is that the **supersecret P8 project** has made some sort of breakthrough and that the P7 will be a short-term design. This is utter nonsense. In fact, because of the way Intel rotates different teams in the design of these chips, the odd-cycle chips (the 80386 and the Pentium, for example) have been known to be superior—with the exception, of course, of the inconsequential 80186 chip.

The other rumor is that the **P7 will not be backward-compatible** with the x86 instruction set. This rumor stems from the belief that HP's version of the P7—designed for workstation and minicomputer uses—will probably not incorporate any x86 circuitry. The Intel chip will be compatible, for sure. But Intel is looking at how the Motorola PowerPC successfully emulated the 68000 using software. How long the x86 instruction set stays in the line after the P7 emerges remains to be seen. I think it depends on how many people insist on using DOS and Wordstar into the next century.

China Watch: While Intel stomps the competition at home, Cyrix's chip may have found an ally in—of all places—China. But it looks like it will be the IBM version of the **5x86 that shows up in the mass-market box** just announced by Acer. While Cyrix designed the 5x86, IBM Microelectronics has a license to manufacture it, and it looks as if **the processor in the new ma-**

*Intel is not happy
with people lingering on
the P5 platform. The
company has made it clear
that it wants no part of the
low end of the business.
Intel's strategy is based on
upgrading users to newer
and newer processors.*

chine will carry IBM's name, not Cyrix's. The system is the product of a joint venture between the Acer Group and the Beijing-based Legend Group—each considered to be the largest PC vendor working either side of the Chinese fence.

The machine is the **AcerBasic** and it will **sell for \$500**. Using a 100-MHz IBM 5x86, the AcerBasic will sport a 100MB Iomega Zip drive instead of a hard disk. Sounds like the **perfect Web-surfing machine** to me.

While on the subject of Web-surfing machines, look for a lot of offbeat machines over the next 24 months, including some using a **quasi-Java-specific microprocessor called the ShBoom**.

This chip, made by San Diego, California-based Patriot Scientific, was originally designed to run high-speed, embedded Forth applications (a stack-oriented language that was faddish in the early 1980s). It turns out that Java acts enough like Forth in its execution for this chip to be **perfect as a Java processor**. Or so they say. At the very least, it's different. Last October, Patriot received the first U.S. patent for its ShBoom microprocessor. That same month, Patriot announced positive results for its second generation of ShBoom processing technology.

The first company to popularize this new chip may be the Birmingham, Michigan-based WebBook Co., which is going to produce an **inexpensive, portable computer-like device** for surfing the Web. These chips have to **compete for mind share** with another type of chip expected to find use in cable modems: **media processors**. (The first chip in this category, I believe, was the one developed by MicroUnity—sounds like some kind of religious cult.) Media processors are designed to process **huge streams of high-speed data**, such as a cable signal. Since these processors were first conceptualized, a lot of big names—such as ThompsonCSF—have thrown millions at them. The most impressive implementation, according to *The Microprocessor Report*, will come from Samsung.

Samsung has become the world leader in memory technology. The most obvious sign of Samsung's leadership in this market is that the company has broke ground on a **new \$1.3 billion fabrication facility** to make memory chips. And where will this facility be located? In Austin, Texas, where labor is cheap, apparently. Who says we can't make memory chips in the U.S.? This state-of-the-art plant will also give Samsung entrance into the technology community in Texas, where a lot of high-end engineers work for IBM, Motorola, Ross, and other processor designers. Can you say head-hunting? □

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That Hot New OS—Win 3.x

There hasn't been a moment like this in the world of PC operating systems since the first IBM PCs went out the door 15 years ago. One operating system has always been dominant, and overwhelmingly so. For more than a decade, it was DOS; today

such competitors as CPM/86 and the UCSD p-system are faint memories indeed. But now we have a hot contest going between two very different PC operating systems, with a third one quickly muscling in from the sidelines. My guess is that all three will have substantial installed bases for the next two to three years.

The two major contenders? Windows 95, of course, and... Windows 3.x. What? Ancient Windows 3.11 and Windows for Workgroups 3.11 still in the running? You bet. In fact, taken together, these aging Win 3.xs have the largest market share in the PC OS universe. Windows 95 may have sold 40 million copies over its first year, August 1995 to August 1996 (mainly as preloads on new PCs, of course), and Dataquest's estimate of total Win 95 sales for the calendar year 1996, 46 million units, sounds about right. But Dataquest also forecasts sales this year of 21 million copies of Win 3.x, and based on my experience in large corporations, that may be low.

Windows NT Workstation 4.0 is the third contender, the hot newcomer: a product that, as regular readers know, I'm convinced will be the dominant business PC operating system in two to three years. But Dataquest estimates that Microsoft will sell only 4 million copies of Win NT Workstation this year. That's an impressive number—and, again based on my experience, may be low, off by as much as 25 percent—but it's not yet close to either of the market leaders. (OS/2 is in there, too, with a single-digit market share, but I'm convinced it won't be a meaningful factor over time.)

As appealing as Win 95 and Win NT 4.0 may be, and as popular as both are with many *PC Magazine* readers, we're going to see Win 3.x entrenched for a long time to come, especially in business. A few data points of interest: • Microsoft says that about half the current sales of its Microsoft Office bundle consists of Office 95, for Win 95—but about half still consists of the older Office 4.3, for Win 3.x. Sure, the old Office apps will run under Win 95, but no users in their right mind would buy a new copy of Office 4.3 for a Win 95 machine. And Office isn't cheap: Customers buying

it today clearly expect to use it for some time to come.

- Symantec says it has finally turned the corner on Win 3.x/Win 95 apps: It's only now shipping as many Win 95/Win NT copies as Win 3.x packages.

- Though the major PC makers made the switch to Win 95

preloads from Win 3.x more than a year ago, they still get a substantial number of corporate orders of Win 3.x. For example, one major PC vendor's run rate for machines shipped in July was 55 percent Win 95, 39 percent Win 3.x, and 5 percent Win NT 3.51.

Speaking at a corporate retreat recently, I put up a slide with my estimates of the relative market shares of all operating systems in businesses with more than 500 PCs, through the end of the century (conveniently, just three years off). It sparked an argument among the participants that lasted more than an hour. Everyone agreed with the past and current figures on the slide, while expressing amazement at Win 3.x's enduring strength, but at first almost no one could accept my forecast of a substantial Win 3.x installed base for another two years. I said little and just listened. Slowly, the group began to turn around, as the people in the room began to offer their own reasons why Win 3.x might indeed hold on so long. By the time we moved on to the next slide, there was general agreement that my estimates—that Win 3.x will still hold a 26 percent installed-base share a year from now,

and as much as 8 percent in June 1998—were about right. A few even thought them low.

Why should so many corporate shops stay so long with what many consider an obsolete product?

First, Win 3.x *works* for them. It's in place; their support structures are in place; leaving things as they are doesn't cost anything. There is enormous inertia among IS management in large companies, a resistance to change born of companies' profound need for stability and security. Absent an overwhelming reason for change, you don't move your PC users to a new operating system.

Second, there is skepticism about the merits of Win

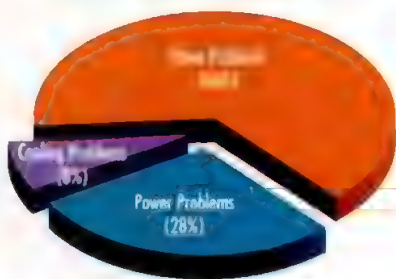


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95. At almost every company I know that has moved to Win 95, there is a clear sense that it was the right decision. But you have to experience that yourself; hearing or reading about it isn't the same thing. Part of this worry, certainly, is the old reluctance to use Version 1.0 of anything—especially a Microsoft product.

Third, there has been—with justification—a strong sense in Corporate America that Win 95 is only a half-step, that the real upgrade for businesses would be Win NT 4.0. Now that Win NT 4.0 is available and generally living up to expectations, many IS managers are actively planning a move to it—and feeling entirely, even smugly justified in having skipped the Win 95 cycle.

Fourth, even if they like Win 95, these days IS people are caught in serious budget binds. If you estimate that moving a user to Win 95 costs only \$1,000—and the amount is probably two or three times that much—it's easy to see how expensive an upgrade can be when you're managing a fleet of hundreds or thousands of PCs.

Finally, making any change on this scale in a sizable business takes a long time. No matter how gung ho an IS manager may be for a new OS, the process of evaluation, selection, purchase, setting up support, and actually rolling out a new operating system to users' PCs is at least a two-year cycle, usually longer. And from the day the decision is made to the day the last user's PC is upgraded or replaced—including installation of the new OS, productivity apps, and company-specific apps, and transfer of the user's local-storage data to the new box—IS must cope with the costs and strains of maintaining both old and new systems.

None of these reasons justifies staying with an obsolete OS; I still think companies should migrate to Win 95 or, more likely, Win NT with due speed. But in the real world, a change of this magnitude does not happen in a year or two. We'll see Win 3.x around for a long time to come.

In the broadest sense, of course, we still have just one dominant operating system: Windows. That it comes in three widely used flavors doesn't fundamentally change the old rule about one operating system always being dominant. But balancing those three flavors is a job that's already causing confusion and frustration, as individuals and corporate IS managers alike struggle with tricky "which," "when," and "how" questions. □

Bargain-Basement Printers

The bean counters are winning. Accounting and marketing managers are the ones making the \$149 color ink jet printer and the \$299 laser printer possible. They're telling engineers, "Design out all the excess functionality or you'll never see your

stock options again." The prices are right, but I'm not sure these are the kinds of printers you want on your desktop.

The core functionality is there: crisp, 300-dot-per-inch resolution; four pages-per-minute printing for lasers; adequate color and text printing for ink jets. What's missing are the features that make these products convenient to use. In this issue, we review 13 personal ink jet printers and 17 personal laser printers, more than a few of which have been severely cost-reduced. Here are some things to keep an eye on if you're buying these printers for yourself or for individual desktop printing needs:

- **Three-color ink jet printing.** At \$150 to \$200 for color printing, ink jets are a great deal, but they are all three-color, or CMY (cyan, magenta, yellow) printers that require you to alternate between color and black ink cartridges. If you want to print color graphics and black text on the same page, you get process black. The output is slow and a bit fuzzy. Also, these printers often have minuscule ink tanks. A rule of thumb is the smaller the cartridge, the higher the cost per page. Stick with four-color (CMYK) printers.

- **GDI laser printing.** GDI, or Graphics Device Interface printers are also called Windows printers—as in Windows-only. By removing a \$25 microprocessor from inside the printers, vendors can sell these printers for \$50 to \$100 less. It's up to your PC's CPU to create, or *rasterize* the images you print. With GDI, the printer grabs the lion's share of the PC's resources, causing your keyboard and display to respond sluggishly. So unless you're the world's slowest typist, if you're printing a long job you might as well take a coffee break.

- **Minimalist paper-handling.** The paper trays on inexpensive printers may hold only 50 or 100 sheets rather than 200 or 250. There may be no envelope slot (on lasers), so you have to remove the paper tray to feed envelopes. And, though not an uncommon phenomenon for ink jet printers, we're seeing more laser printers with relatively straight-through paper paths (a plus) that don't flip the paper as it emerges into the output tray (a minus), causing

the pages to land in the tray in the wrong order. There's even a printer that doesn't have any output tray at all: The printed pages simply spill onto your desktop.

- **Skimpy starter supplies.** When you buy a personal photocopier, you have to shell out an extra \$75 to \$100 immediately for a print cartridge, because it's not included. With PC printers, it's not as bad, because you do get ink or toner, though perhaps not as much as you'd like. Some laser printers come with "starter" toner cartridges good for only 1,000 pages. The replacement cartridges you buy will last through two to three times that amount. Color ink jet printers advertised as "color capable" may come with only the black ink cartridge; to print color, you have to buy a separate color cartridge for \$20 to \$35. Conversely, we saw one color printer that you could call "monochrome capable"—it doesn't include the black ink cartridge.

- **Flimsy construction.** Several of our testers and reviewers mentioned that the plastic seems thinner—even flimsy—on some of the low-cost printers. This doesn't bother me as long as the printer case holds all the parts in alignment and keeps dust out. Besides, no matter how stiff its case, if you drop a printer on a hard floor, it's virtually guaranteed to break.

Two other cost-cutting items that don't bother me that much are the missing on/off switch on some printers and the missing control panel, replaced by an on-screen status panel supported by a

bidirectional printer cable. Printers don't draw much power in idle mode, so there's really no reason not to leave them on all the time. And in the decade-plus time I've been testing and using printers, I've only seen a handful of truly useful front panels. Their absence is no great loss.

Finally, I still can't fathom why sellers of personal printers don't include a decent cable, which costs less than \$5 to make—especially since old cables may not support bidirectional communications. Actually, there is a reason: With prices and margins so low on printers, a cable that sells for \$10 adds a healthy chunk of profit to the printer sale. Some business, huh? □



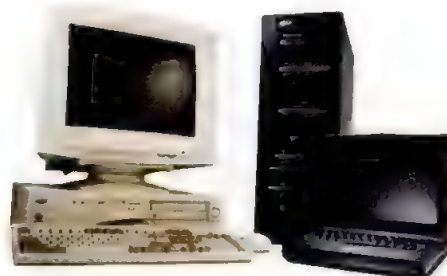
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Where things are



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was, in my mind, the key to improving my game. After all, I kicked my boss's butt on the doglegs, but I always seemed to hook wildly on the straight holes. With one search, I found [Improve Your Golf Game](#), which suggested rethinking the path of the drive. So I scrolled down my search list and took a [Private On-Line Golf Lesson](#), which profiled me as over-competitive and tense. At first I balked, but then I clicked into [Better Golf Through Hypnosis](#) and realized my type-A drive was getting me nowhere. So I signed up for a week-long Zen



golf camp at the [Golf Orgy](#) Web site. Not only did the relaxation techniques improve my swing tempo, my doctor believes they also

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By Tony Pompili

Recently you were asked to integrate expense information collected on your PC's FoxPro system with the corporate accounting journal running on one of your company's AS/400 midrange systems. Now you have to figure out how to connect your PCs to what you've always thought of as a mysterious black box. Don't panic. *PC Magazine* has discovered that IBM and a group of third-party vendors have evolved the AS/400 into an accessible PC resource with a rich variety of PC software and hardware compatibility products. You can now connect your AS/400 to your network using standard IP.

ILLUSTRATION BY ALAN BASEDEN

INSIDE



When worlds collide, good things can happen. PC networks and the AS/400 have lived in different worlds since 1988, when IBM introduced its robust

midrange platform. AS/400s have been busy running their powerful, specialized line-of-business applications, while PC networks have continued to support the mainstream software requirements of the masses. It's gotten easier and easier to bridge the two worlds, however, and there are real advantages to doing so.

LINK AN AS/400 to a PC network and you can wind up with a powerful file, Web, or database server yet still take advantage of the ease of use and flexibility of the Windows environment. You can even run Lotus Notes or NetWare on IBM's platform, and run your AS/400-specific, green-screen accounting applications at the same time.

AS/400 CONNECTIVITY applications make it happen. Contributing editor Tony Pompili examines Windows-based products that let you access your AS/400 applications, grab data from and add data to your DB2 for AS/400 database management system, and move files between the two platforms using Windows 95 Explorer.

CUT DOWN ON FAX BILLS with one of the intelligent fax-routing products tested by author Sean Gonzalez for First Looks. NetXchange Communications' Internet Fax Exchange can decide if it's cheaper to bounce a fax to Los Angeles over the WAN, then to Tokyo over the phone lines—or to just send it to Tokyo directly. (Page NE47.)

GIGABIT ETHERNET is an exciting new technology that promises to steal some of ATM's thunder, at least for now. Senior Networking Editor Frank Derfler discusses Gig Ethernet's pros and cons in Multiple Access. (Page NE68.)

—Leon Erlanger

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The New Model 150: More PC-like than Ever

In the past, buying an AS/400 usually meant blowing holes in your IT capital budget. The idea of low-cost-of-ownership and a full-featured integrated software package didn't make writing the \$100,000-to-\$1-million check that much easier. And if cost was not enough to deter you, the hardware itself was an enigma. Operations groups familiar with PC cards and pop-in SIMMs found the AS/400 and IBM Blue services technicians on a technical level foreign to them. But this may have changed with a new, low-cost AS/400 model—a PC-like system, shipping in the first quarter of 1997, that could make IT groups reconsider the AS/400 as a business and PC application solution.

Called the AS/400 Advanced Entry Model 150 (\$8,000 to \$12,000 depending on configuration), this box brings many PC-like architectural features to the once-proprietary AS/400 realm. Aside from running the full OS/400 (including the complete management, connectivity and database applications), the Model 150 will also offer an optional PCI-based integrated server add-in card that allows you to run a NetWare or Notes server. The Model 150 will feature a 64-bit 133-MHz PowerPC AS processor with a 32-bit bus. It will come standard with 4GB of hard disk (DASD, or direct access storage device), offer a 7.5-millisecond average seek time, and will work with IBM's new OS/400 V3R7 (Version 3, Release 7).

IBM designed the Model 150 with PC-like concepts. For example, the Model 150 uses SIMMs similar to those in PCs. Unlike PC RAM, however, the AS/400 SIMMs perform error-checking, so it's unlikely that you'll be able to find a

third-party source easily. Similarly, while the bus is based on the PCI standard used in most PCs these days, you will not be able to put such off-the-shelf PCI products as Ethernet adapters or video adapters into the Model 150. Nonetheless, IBM's standardization of more-common components has enabled the company to deliver a full-fledged AS/400 in a fairly inexpensive package. And though many of the Model 150 components are not readily available, they can be installed by an IT department's existing hardware specialists. The AS/400 Advanced Entry will hold up to 64MB of RAM and is expected to support about 20 AS/400 5250 users. The optional Integrated PC Server will come with a 133-MHz Pentium and 128MB of RAM, allowing those running NetWare to handle a number of file sharing and print clients comparable to what NetWare handles running on a typical 133-MHz Pentium PC server. A faster version of the board should be available by mid-1997.

Traditionally, IBM has leased its software rather than licensed it. But with the introduction of the Model 150, they will license the software.

While not quite powerful enough for use as a full-bore production server, the Model 150 is certainly a viable solution for satellite offices. It is especially well-suited for running AS/400 applications and PC server applications on a single box. Because it has the same AS/400 management and connectivity software as previous models of the AS/400, you can connect and manage the system with the enterprise tools in your existing AS/400 environment.—TP

IPX, and LAN protocols and use it to run NetWare and Notes server software; provide PCs with connections to the AS/400's own powerful databases using familiar ODBC database drivers; and do file transfers with your PCs using a Microsoft Windows Explorer interface.

On the following pages we take a close look at how the AS/400 can become a powerful PC resource. We found a broad range of products that provide everything from basic connectivity and green-screen terminal emulation to AS/400 database access to native PC servers running right on the AS/400. The result is the marriage of a high-end corporate computing system with the popular PC environment. But before you throw the rice, take a look at our findings.

ROAMING THE MIDRANGE

With over 380,000 systems installed—the majority outside the United States—the AS/400 has become a popular international business system. The most recent line, called the AS/400 Advanced Series, is even attracting mission-critical applications such as SAP, which traditionally has been a Unix-only accounting-to-manu-

facturing system.

The AS/400 continues IBM's tradition—reaching back to the System 38 and System 36—of delivering general-purpose business systems. Unlike larger mainframe systems, the AS/400 is pretty

*One of the most attractive
advancements in AS/400
and OS/400 technology is
the movement toward
open architecture.*

much self-contained. It comes complete with all the software a business should need, including programs for management, electronic mail, and communications. At the core of the AS/400 is OS/400. The current version of OS/400 is a 64-bit system; previous versions were 48 bits. IBM prides itself on the AS/400's ability

to migrate users and applications from one version of OS/400 to the next. For example, the AS/400 is able to convert older 48-bit applications to 64 bits without having to recompile. Instead, the AS/400 performs on-the-fly application translations.

OS/400 V3R7 (Version 3, Release 7), the recently upgraded version of the OS, includes a built-in database system called DB2 for AS/400. Similar to its System 370 counterpart, DB2 for AS/400 is a SQL-like database that can be used as a typical DBMS, to store RPG application code, or to define file systems as part of the integrated file system (IFS). DB2 for AS/400 and IFS are so flexible that they can emulate file systems for nearly any platform including, of course, the PC.

On the hardware side, the AS/400 comes in two basic architectures: the older CISC (complex instruction set chip) IMPI (internal microprogrammed interface) and the newer RISC (reduced instruction set chip) PowerPC AS. It's the PowerPC that brought 64-bit processing power to the AS/400.

One of the most attractive advancements in AS/400 and OS/400 technology is the movement toward an open archi-

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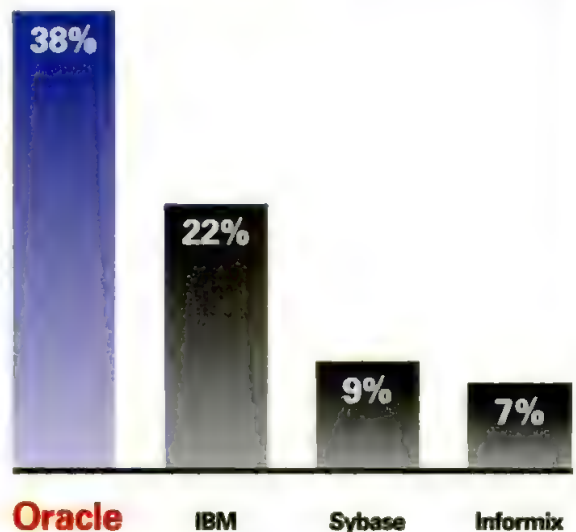
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The AS/400 Connection

The lineage of the AS/400 goes back further than the PC's. And until today, making PC to AS/400 links has never been easy. But a standard connection method has evolved. AS/400s now work with twisted-pair, Ethernet, FDDI, Token-Ring, and a variety of slower connections, such as Async, Bisync, ISDN, and X.25. Historically, IBM has preferred making connections across its 4-Mbps and 16-Mbps Token-Ring LANs to using Ethernet, but you can get Ethernet adapters for the AS/400.

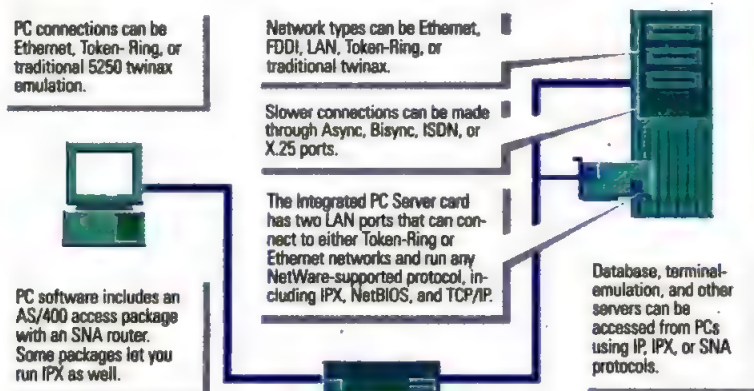
While the wiring for AS/400s is familiar to PC users, the

protocols are not. AS/400s typically use IBM's Systems Network Architecture (SNA) protocol and APPC (Advanced Program-to-Program Communications). SNA carries the data and APPC provides ways for programs to interact, including the AS/400 SNA database server's ability to retrieve data from DB2/400 database tables. Until recently, installations typically used a gateway, such as those offered by IBM, Microsoft, and Novell to translate between the common IP or IPX network protocols and SNA.

In order to make it possible to link AS/400s to IP and TCP/IP LANs, IBM implemented its Multiprotocol Transport Networking (MPTN) services. MPTN lets PCs connect directly to the AS/400 with non-SNA protocols—with a few conditions. Because the AS/400's basic database, file-transfer, and print servers are all still APPC-compliant, you have to run SNA on the PC client even though it may be connecting to the AS/400 over IP or TCP/IP. This is a common feature with client-access products, such as Attachmate's Extra! for the AS/400 or Rumba's Access/400.

IBM does run such basic TCP/IP servers as telnet and FTP that do not require SNA data streams, but the functionality of these terminal and file-transfer utilities is limited compared to those of SNA servers.—TP

Typical PC-to-AS/400 Connection



architecture. Traditionally, you connected 5250 terminals to AS/400s with twinax cable. You could connect to the AS/400 over Token-Ring, but in order to do so you had to run IBM's system-wide mainframe networking protocols—SNA (Systems Network Architecture) and LU6.2 APPC (advanced program-to-program communications interface). Fortunately, IBM has made strides to simplify connecting AS/400s to PC LANs. IBM's Multi Protocol Transport Networking (MPTN) connects AS/400s to your Token-Ring or Ethernet network running familiar PC protocols such as TCP/IP and IPX.

In case standards-based connectivity is not enough, IBM has taken steps to make the AS/400 more PC-friendly by letting you physically plug in a pseudo-PC on a board. (See "PC Server Products.") Though it is not a full-fledged PC (there's no bootable operating system), the Integrated PC Server card does let you run such popular shrink-wrapped versions of PC server applications as Novell's NetWare 4.1 and Lotus Notes 4.0 Server. Both users and administrators can access them the same way they would any other server, and the AS/400-based Notes

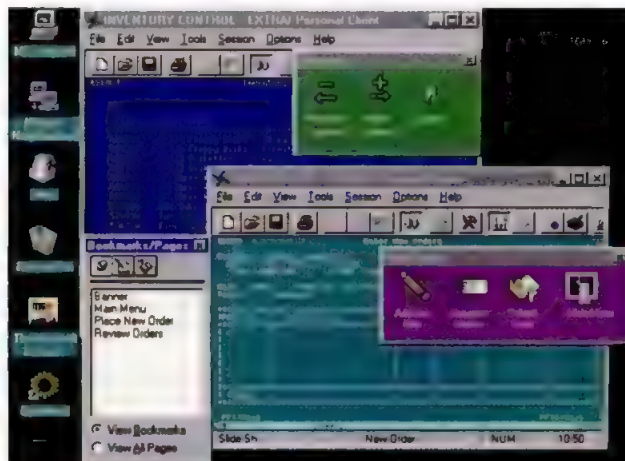
and NetWare servers can talk to other AS/400 servers on the network. Piggybacking PC applications directly on the AS/400 makes life easier, since you can run both without having to install and manage two different hardware platforms.

With the introduction of a new low-end, PCI-based system, IBM is trying to dispel the myth that AS/400s are expensive.

The Advanced Entry Model 150 (starting at \$8,000) makes it possible to consider moving an AS/400 out of the glass room and placing it in your PC development area. We're not suggesting you junk your server room full of Compaqs for a low-end AS/400; combine the AS/400 with your PCs to create a powerful business computing system instead.

THE AS/400 BECOMES ACCESSIBLE

Networking and systems architecture are important, but what you really want is the ability to access AS/400 data and resources from popular PC software. At the most basic level, you want to be able to run your AS/400 green-screen applications in Windows 3.x or Windows 95 (See "Basic Access Suites"). The products that let you do



ATTACHMATE EXTRA! Personal Client gives you terminal enhancement features, such as bookmarks, for moving quickly among 5250 screens.

#

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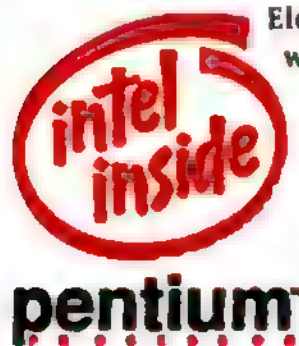
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IBM Corp.	AS/400 Client Access for Windows 95	\$300 per user	800-426-2255	None	www.as400.ibm.com/client/cahome.htm
NetSoft	Behive	\$39	888-638-7638, 714-753-0800	714-753-0810	www.netsoft.com
Wall Data Inc.	Rumba Access/400 95/NT for the AS/400 5.0	\$400 per user	800-915-9255, 415-812-1800	415-858-9285	www.walldata.com
WRQ Inc.	Reflection for AS/400 6.0	\$135 per user	800-872-2829, 206-217-7100	206-217-0293	www.wrq.com
Database and Application Access					
Attachmate Corp.	Extra! Personal Client 6.1	\$425	800-426-6283, 206-644-4010	206-747-9824	www.attachmate.com
Best Inc.	Win/400 or Win/400 for Clipper	\$1,150	800-291-2098, 305-470-9051	None	www.win400.com
Integral Group Inc.	DCS/400	\$1,000	905-764-2922	None	None
Sybase Inc., Powersoft Business Group	PowerBuilder for Windows 5.0	\$295	800-395-3525, 608-267-1500	508-287-1800	www.powersoft.com
Wall Data Inc.	Arpeggio for the Developer	\$650 per user	800-915-9255, 415-812-1800	415-858-9285	www.walldata.com
Peripherals					
IBM Corp.	Integrated PC Server Board	\$3,000	800-426-2255	None	www.as400.ibm.com
Workgroup Applications					
IBM Corp.	OS/400 Enhanced Integration for Novell NetWare	\$1,000 per user	800-426-2255	None	www.as400.ibm.com

this are the most mature of the AS/400 connectivity products and come from such established third-party vendors as Attachmate and Wall Data. Being able to offer Windows enhancements—such as hot spots to activate terminal function keys—has made accessing 5250 applications from PCs easier than ever.

High-speed printers connected to AS/400s can now also be used by PC folks. IBM's own AS/400 Client Access software makes it possible to connect and print to high-speed AFP or SCS printers using standard Windows Print Manager tools.

Database access is probably the most titillating attraction of the AS/400. The ability to view and query AS/400 and DB2/400 tables and records is where the AS/400 and PC union is most compelling. With such products as Wall Data's Rumba Access/400, you can create and save ad hoc queries and import and export data among your PC and AS/400 applications (See "Database and Application Access"). OLE 2.0 support in such access packages as Rumba make it possible to save host sessions as OLE objects and insert them into such OLE container applications as Lotus's WordPro.

For existing PC database applications that are written in Clipper, FoxPro, or Microsoft Access, you want to be able to use DB2/400 tables without hiring an AS/400 RPG language developer. *PC Magazine* found a variety of vendors, including HiT Software, IBM, and WRQ,

that have developed database drivers that you can add to your Windows ODBC Manager, allowing you to access the DB2/400 database from your PC. For general-purpose applications that support DDE (Dynamic Data Exchange) and OLE (Object Linking and Embedding), products such as the Integral Group's DCS/400 AS/400 Access API make it possible to retrieve nearly any DB2/400 information that you want at the program level.

THE AS/400 AND THE INTERNET: A GIVEN
IBM is determined not to leave the AS/400 out in the cold when it comes to the Internet. On the most basic level—the TCP/IP suite—the AS/400 acts as a typical IP server with applications such as a telnet and FTP server. Some PC access programs have actually implemented their file transfer around the AS/400 TCP suite.

But the more exciting angle of the Internet story is the recent release of the AS/400 Internet Connection. This suite of products provides software that lets you automatically Web-enable existing 5250 applications, run a general purpose CGI-compatible Web server, or use included templates to provide access to DB2/400 databases from a Web application. Because the Internet Connection comes bundled with OS/400, every AS/400 is Internet- or intranet-ready.

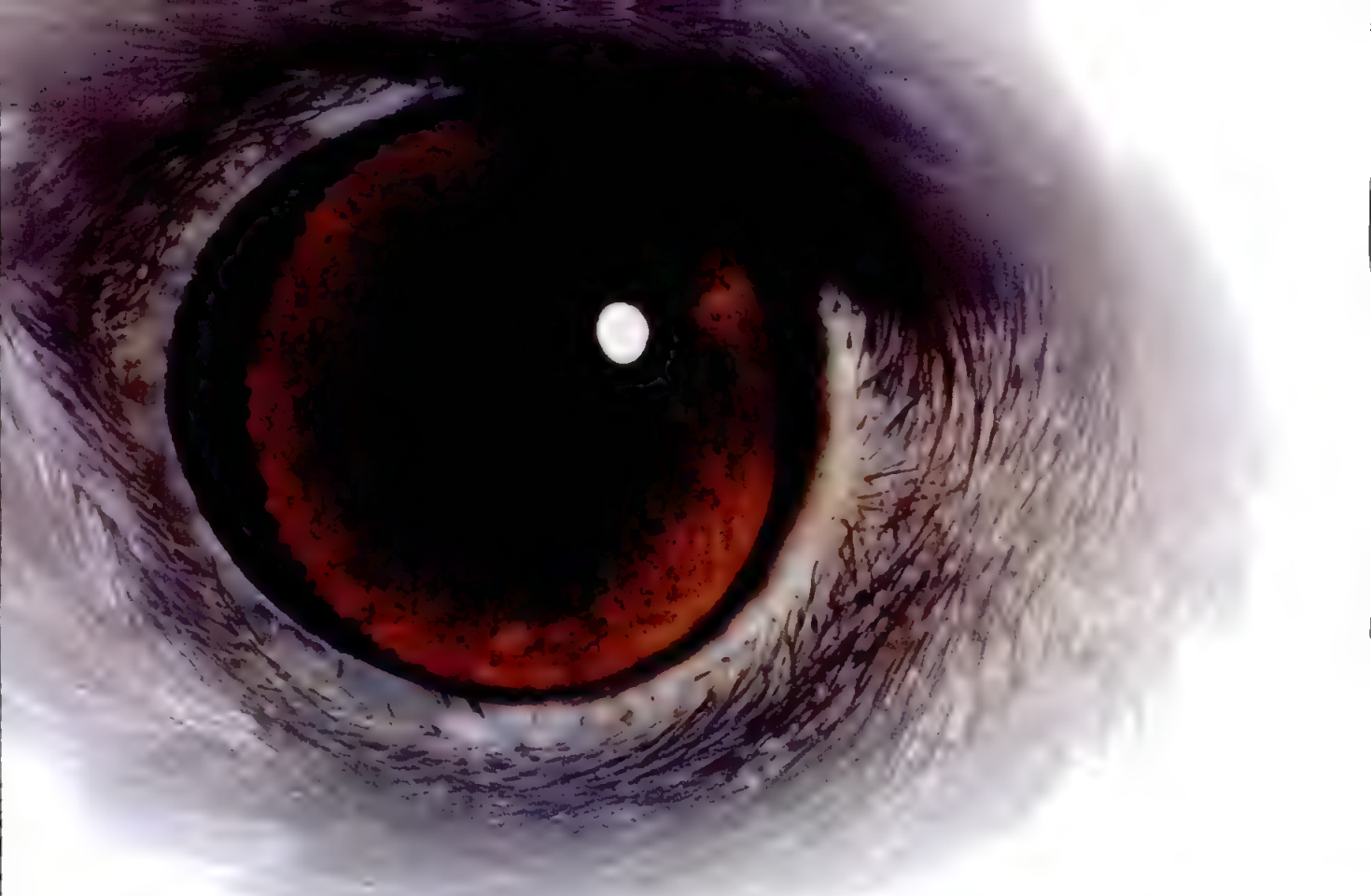
What was formerly the mysterious black box can now be a productive citizen of your PC-based network.

PC Server Products

Any talk of absorbing IBM's AS/400 into the PC community inevitably leads to a discussion of server applications. Using the AS/400 as a PC server may not be in the forefront of most technology managers' minds, but the AS/400-PC combination has some significant advantages. For example, backup—and other everyday maintenance tasks—can be run for both platforms from a single AS/400, thereby eliminating the need for multiple backup systems.

There are also advantages when it comes to deploying applications. For example, say you want to implement an existing brokerage system in several branch offices. The business software is an RPG-coded system already running on an AS/400, but the satellite sites also need PC file and print services. Consider putting both together into a single AS/400 supported by a single operations organization.

Some PC server applications, such as the AS/400's Internet Connection Services, run natively on the AS/400. Regular off-the-shelf versions of NetWare 4.1 and Lotus Notes 4.x run using IBM's **Integrated PC Server**, a plug-in board that comes with a 66-MHz 486 processor and up to 64MB of RAM and works with any AS/400 model Advanced System or Server (See "AS/400 Advanced Series"). In the first quarter of 1997, IBM plans to ship a 166-MHz Pentium board with support for up to 256MB of RAM.



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IBM's OS/400's INTEGRATION of Lotus Notes lets you import DB2 for AS/400 data directly into Notes databases.

The Integrated PC Server is not a full-fledged PC on a board, and it cannot run every PC-based application. Rather, it is hardware with PC components that can run specific applications that IBM has configured for the AS/400. The OS/400-to-PC-application bridge is provided by specialized NetWare and Notes install scripts built into OS/400. While the setup is not the same as a PC setup, the result is the same—a PC server running on an AS/400. Right now, the list of servers includes NetWare and Lotus Notes, but IBM is also looking at Windows NT Server and other products that compete with the AS/400. A single-user license of Lotus Notes is actually shipped with the Integrated PC Server.

The hardware is based on a standard AS/400 form factor. Similar to PC add-in cards, the Integrated PC Server plugs directly into the AS/400 bus. While the Integrated PC Server can use only the memory available on the card, it shares the AS/400's DASD (direct access storage device) for storage.

The Integrated PC Server holds only a single processor, so it's not as appropriate for supporting a large Notes site as a typical multiprocessing PC server. Depending on the model of AS/400, however, you can add as many as 16 individual Integrated PC Server cards to a single AS/400, and they share the same storage resources. You can also back up your NetWare file system at the same time you back up your AS/400 files.

The Integrated PC Server also has two plug-in adapter modules, each of which can support Ethernet or Token-Ring. You can use the Integrated PC Server modules for both your PC and AS/400 network con-

nections, but you cannot use Ethernet or Token-Ring installed in the AS/400 itself for PC connections.

The new low-end AS/400 Advanced Entry 9401 Model 150 will come with a version of the Integrated PC Server designed to work with the Model 150's PCI bus (see "The New Model 150: More PC-like than Ever"). According to IBM, it will be available in

the first quarter of 1997 and initially include a 133-MHz Pentium and support for up to 128MB of RAM. IBM expects a 166-MHz version of the processor by mid-1997. The board also offers two adapter ports, each of which can be configured for either Ethernet or Token-Ring.

Both options are relatively inexpensive. The AS/400 Advanced Architecture version costs \$2,600, while the AS/400 Advanced Entry version is expected to cost about \$2,000, according to IBM. Assuming that you're planning to add a server to an existing AS/400, the Integrated PC Server approach for NetWare or Notes is attractive.

NETWARE ON AN AS/400

Though installing it on the AS/400 is very different from its typical installation, NetWare on the AS/400 runs much like it would on a standalone PC server. Your AS/400 must run OS/400 V3R1 (Version 3, Release 1), V3R2, or V3R7. In the case of V3R7, NetWare is loaded from the AS/400-based CD-ROM drive. With other versions, it's loaded from floppy disks.

IBM provides disk drivers that make the AS/400 DASD look like typical NetWare devices, and you can use the typical NetWare install disk utilities for creating and managing volumes. One major difference in NetWare AS/400 operation is that there's no console directly attached to the server. This means server administration is done using NetWare's Remote Console over the network. Of course, you can use standard IPX/SPX as the network protocol between your users and server; PC users logging onto the server will not be able to tell the difference between NetWare on an AS/400 and NetWare on a standard PC system.

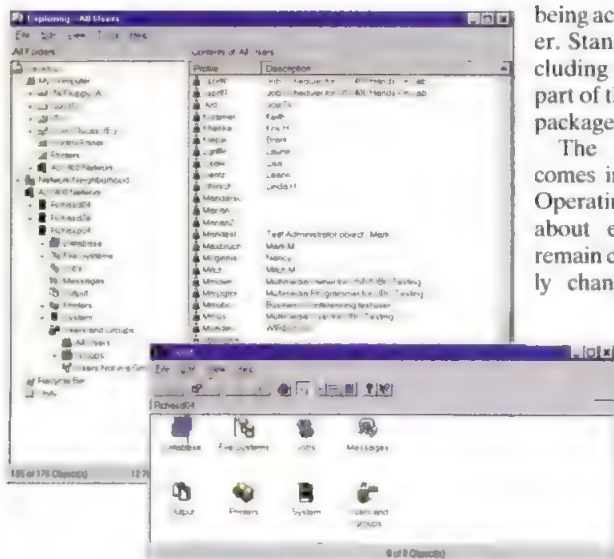
If you're AS/400-centric, OS/400 V3R7 provides hooks into NDS (NetWare Directory Services) or NetWare Bindery, allowing you to keep both systems' User Profiles or Group Profiles in sync. If you change an AS/400 profile, it is automatically updated in NDS or NetWare Bindery. In a NetWare environment, the AS/400 can run over IPX/SPX and TCP/IP. In fact, the AS/400 can serve as a NetWare router among multiple Integrated PC and conventional NetWare servers.

IBM also recently introduced a combination AS/400-NetWare management package called **OS/400 Enhanced Integration for Novell NetWare**, designed to help AS/400 administrators manage common NetWare and AS/400 users from a Windows 95 workstation anywhere on the network. The software is implemented as an NLM on each server. OS/400 Enhanced Integration for Novell NetWare allows the AS/400 to set up and modify user information ranging from rights to print access.

AS/400 TAKES NOTES

Not surprisingly, the AS/400 division has implemented its sister product **Lotus Notes** (OS/2 Version) on the Integrated PC Server. IBM wrote an AS/400-specific installation script and added a few bells and whistles to integrate Notes user management. To get your company started, a free Notes 4.x server and client license comes with every Integrated PC Server. To streamline mail routing management, IBM has integrated Notes into its built-in AS/400 mail management software. AS/400 mail uses the Notes SMTP OS/2 MTA to exchange mail with native AS/400 mail. Creating a new Notes user in the AS/400 System Distribution Directory—its mail directory—automatically generates a Notes ID and sets up the mail file for the user.

One powerful benefit of the AS/400 Notes implementation is direct access to the DB2/400 database. As part of IBM's **Integration Enhanced Pak**, you get the ability to set up Notes OS/2 processes to import and export Notes and DB2/400 data. DB2 integration is managed from a Notes client pull-down menu item, which is added during the Integration Enhanced Pak installation. You can use SQL queries to specify what data you wish to import directly into a Notes database. These databases (accounting journal entries or sales transactions, for example) can be incorporated into other applica-



IBM's PROJECT UNITY SERVICES, recently added to AS/400 Client Access for Windows, lets you perform AS/400 administration from Windows 95 Explorer.

tions using standard Notes development tools. Besides running the DB2 integration program on OS/2 Warp, you can use it from a Windows 3.1 or Windows 95 workstation.

MIDRANGE INTERNET

IBM recently released an AS/400 Internet package of services that allows PCs and any other Internet- or intranet-connected users to access standard mail, newsgroups, Web servers, and AS/400 applications via a standard Web browser. The **Internet Connection** suite of products includes a CGI-based Web server at its core. Using its native TCP/IP support, an AS/400 can be connected to the global Internet or local private intranets in the same way as Netscape FastTrack or Microsoft Internet Information Server.

You can also write CGI and other scripts to access DB2/400 data on the same or other networked AS/400s. To simplify DB2/400 access, the Internet Connection HTTP server comes with a group of template macros called DB2/WWW, which allow you to provide full database access to your HTML applications.

For existing AS/400 applications, the Internet Connection also includes the 5250-to-HTML Workstation Gateway that translates standard AS/400 terminal applications to HTML on the fly. For 5250 emulation programmers, a new HTML keyword allows you to imbed HTML directly into your 5250 screens and display them when the application senses that it's

being accessed by a Web browser. Standard Internet mail, including a POP 3 server, is also part of the Internet Connection package.

The Internet Connection comes integrated with OS/400. Operating system updates occur about every six months. To remain competitive in the quickly changing Internet market,

IBM says it plans to add electronic commerce servers, a full range of Java support, and tighter integration with Lotus Notes HTTP server, Domino. Though you will still need a mission-critical application to ease the pain of integrating your PC server infrastructure into the AS/400, it is clear that inter-

connectivity has its advantages.

Client Access

If you always thought of the AS/400 as a bunch of green-screen terminals connected to the mysterious big iron IBM SNA network, think again. Access products from IBM and third-party vendors are making the AS/400 much more familiar and accessible to PC users. You can now put a variety of intuitive AS/400 file-transfer, database-access, and terminal emulation tools on your users' Microsoft Windows desktops and run them over your old IPX/SPX and TCP/IP LANs. By doing so, you add the power of the traditional midrange system to the PC environment's own rich file, print, and client/server application services. For example, when connected to an AS/400 you can access high-speed printers for large mass-mailings or retrieve data in the AS/400's DB2 for AS/400 databases. And you can even provide your Windows users with access to the 5250 terminal green-screen applications that run your organization's backbone accounting, payroll, and manufacturing applications.

Which product works

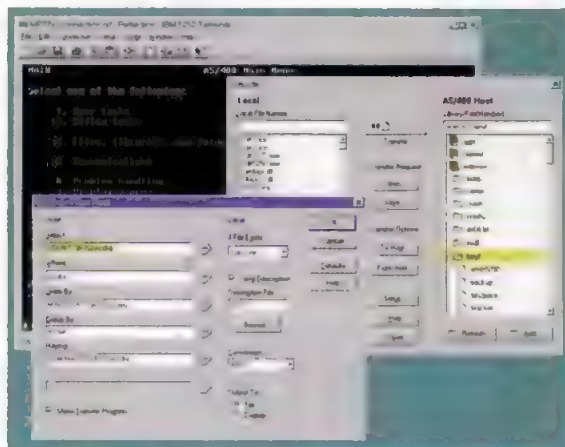
best for you, of course, depends on what you want and how you want to get it. And inevitably you'll have to pair the appropriate collection of tools with the connectivity options that match your environment, whether its true-blue twinax, or more likely, an Ethernet LAN running IPX or TCP/IP.

Architecturally most of the leading AS/400 access products include similar basic components. Some of the better known packages are Attachmate Corp.'s **Extra! Personal Client 6.1**, IBM's **AS/400 Client Access for Windows 95**, WRQ's **Reflection for AS/400 6.0**, and Wall Data's **Rumba Access/400 95/NT**. Each of these clients consists of networking software and access utilities.

The core of networking software is what AS/400 folks call routers. In the AS/400 world, a **router** is networking software that converts access requests into AS/400 server calls and routes them down the wire using the appropriate protocols. Routers are included as part of most access software, but many companies support third-party routers, such as IBM's PC Support or Novell's 5K IPX router.

When setting up client access, the AS/400's MPTN (Multiprotocol Transport Networking) gives you a choice of using either traditional SNA or the more popular PC protocols, such as IPX/SPX, TCP/IP, or NetBIOS. All of the products we saw also provided the option of using either SNA or a PC protocol. This can be important, since using a PC protocol means you don't have to change all of your current user connections over to SNA/5250 running over twinax.

Most of the desktop access tools these packages provide work against AS/400 counterparts called **servers**, which are basically application servers. These include the



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COVER STORY

print, emulation, file-transfer and database servers that are included with the OS/400 operating system. These servers talk only APPC (Advanced Program-to-Program Communications), so PC networks still end up tunneling SNA in IP using software on the client side to remain compatible with the AS/400 and LAN.

Most of the AS/400 access products will run you between \$150 and \$450 per user. For the budget-conscious, NetSoft recently introduced **BeHive**, a streamlined AS/400 access package. Priced at \$39, BeHive offers the same basic terminal emulation, file transfer, and printing to an AS/400 over IP or SNA that the other packages offer. BeHive also offers some unique features including such collaboration tools as a real-time chat utility and a streamlined messaging package. The catch is that it doesn't come with its own router, so you have to use a third-party router like NS/Router or an SNA gateway like Microsoft SNA gateway.

UNIVERSAL ACCESS

Like most of the vendors here, Attachmate is a veteran third-party AS/400 access soft-



Most AS/400 access products will run you between \$150 and \$450 per user.

ware provider. With **Extra! Personal Client 6.1** (\$425), Attachmate has created a universal host PC client package that lets you access not only AS/400's but also IBM and DEC mainframes. Extra! also includes basic TCP/IP and Internet access tools. Available in both 16-bit Windows 3.x and 32-bit Windows 95 and Windows NT versions, Extra! can function as an OLE 2.0 server, letting you embed host sessions in documents, such as a Microsoft Exchange

mail message. Users can establish sessions simply by clicking on the icon.

You can also use Extra! Personal Client's DBQuery cross-host database query tool to access AS/400 databases. You can select data with DB2 for AS/400, DB2, or SQL queries and import results into such Windows applications as Microsoft Access. Extra! also includes collaborative features such as a shared workspace, group conferencing, and document management. For Internet access, Extra! is bundled with Netscape Navigator 2.0 as well as Serial Line Internet Protocol (SLIP) dial-up remote access.

MIRRORED ACCESS

Building on a former client product called PC Support, IBM's **AS/400 Client Access, Version 3** provides Windows 95 users with integrated AS/400 access. With a wizard-based installation and the ability to incorporate hosts into Windows Explorer, IBM hopes to make using Client Access as straightforward as accessing a Windows NT server.

Based on NetSoft's NS/Router for SNA/APPC connectivity, which comes as part of the package, Client Access, is com-

AS/400 Advanced Series

IBM's AS/400 Advanced Series consists of four families of business computers. Advanced 36 models provide a bridge between the older System 36 applications and the current OS/400 applications. The Advanced Portable products, which offer true mobility, are meant for workgroups, small departments, or even small businesses. The Advanced

System products provide balanced performance across all AS/400 applications. A small tweak at the microcode level optimizes the Advanced Server units for client/server computing. IBM is continuing to improve the power of its systems by migrating from CISC processors to RISC processors in the newer machines.

	Starting price	Type of processor	CPW value*	Main storage capacity	Disk storage capacity	Communication lines	Optical libraries
AS/400 Advanced 36							
Model 436	\$9,800	RISC	14.4-24.5	32MB-84MB	1.03GB-3.93GB	1-20	0-4
AS/400 Advanced Portable							
Model P03	\$7,500	CISC	7.3-16.8	8MB-40MB	1.03GB-3.93GB	1-2	0
Model 10S	\$7,000	CISC	7.3-16.8	8MB-56MB	1.96GB-3.93GB	2	0
AS/400 Advanced System							
Model 200	\$8,000	CISC	7.3-16.8	8MB-128MB	1.03GB-23.60GB	1-20	0-4
Model 300	\$17,000	CISC	11.6-21.1	8MB-160MB	1.03GB-117.40GB	1-33	0-8
Model 310	\$95,000	CISC	33.8-56.2	64MB-832MB	1.03GB-159.30GB	1-64	0-14
Model 320	\$218,500	CISC	67.5-177.4	128MB-1,536MB	1.03GB-259.60GB	1-96	0-14
Model 400	\$9,000	RISC	12.3-30.6	32MB-224MB	1.96GB-23.60GB	1-20	0-4
Model 500	\$23,000	RISC	18.7-38.3	64MB-1,024MB	1.96GB-150.99GB	1-33	0-14
Model 510	\$137,500	RISC	66.7-85.0	256MB-1,024MB	1.96GB-318.76GB	1-96	0-14
Model 530	\$275,000	RISC	132.5-509.3	512MB-4,096MB	1.96GB-520.09GB	1-200	0-22
AS/400 Advanced Server							
Model 20S	\$12,500	CISC	17.1	16MB-128MB	1.03GB-23.60GB	1-20	0-4
Model 30S	\$21,650	CISC	32.3-68.5	32MB-832MB	1.03GB-86.50GB	1-33	0-10
Model 40S	\$9,000	RISC	24.5-87.3	32MB-224MB	1.96GB-23.60GB	1-20	0-4
Model 50S	\$24,000	RISC	66.7-130.7	64MB-1,024MB	1.96GB-318.76GB	1-96	0-14
Model 53S	\$52,000	RISC	132.5-509.9	256MB-4,096MB	1.96GB-520.09GB	1-200	0-22

* Commercial processing workload (CPW) value is an internal IBM performance score for all AS/400 systems.

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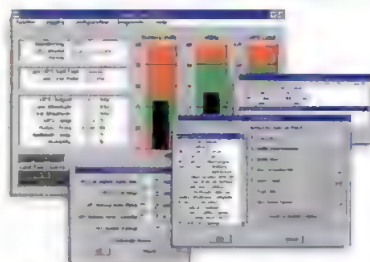
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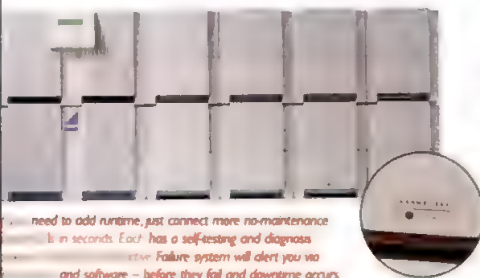
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patible with IP and IPX. IBM departs from the traditional SNA tunneling approach used by many of its competitors and instead works with a set of IBM-designed non-SNA Servers—called *socket servers*—running on the AS/400. Socket servers mirror the SNA print, database, emulation, and other servers. IBM says its approach improves performance, since SNA/APPC data streams don't have to be translated back and forth.

Integrating file transfer into the Windows Explorer lets users work with familiar Windows 95 functions such as move, copy, and delete to manipulate AS/400 files. Client Access also uses the AS/400

WRQ has recently started to include HiT Software's ODBC/400 Lite drivers for DB2 for AS/400. Similar to those of IBM's AS/400 Client Access, the drivers allow PC DBMS developers to provide access to DB2 for AS/400 databases from users' desktop applications. Like AS/400 Client Access and Attachmate's Extra!, Reflection can be used as an OLE 2.0 server, which allows you to embed Reflection sessions in OLE 2.0 container documents created in such applications as Lotus WordPro.

Starting at \$135 per user, Reflection is one of the least expensive AS/400 full-featured host access products available on the market.

nipulate some of your organization's most precious information. At the core of these applications is the storehouse of your companies' jewels: the DB2 for AS/400 DBMS.

PC applications are powerful in their own right. But inevitably you will identify PC desktop and AS/400 applications that benefit from host-to-PC interconnectivity. PC applications gain the vast AS/400 data warehouse and the AS/400 applications can incorporate data from connected PCs.

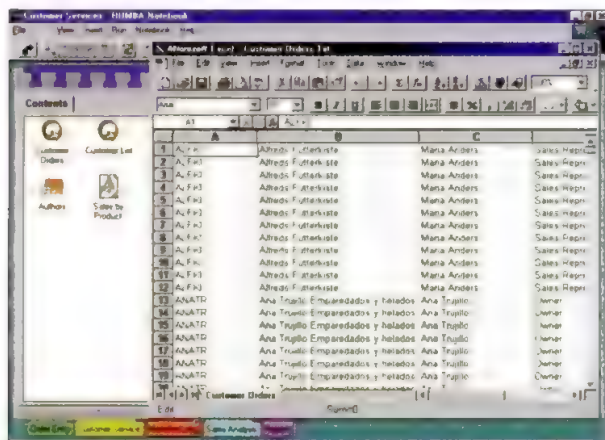
The union makes sense, but the actual interconnectivity may be intimidating. Consider a common scenario: You have existing Clipper, Delphi, or FoxPro database applications written for your Microsoft Windows 3.x, Windows 95, or even DOS operating environments to track invoices submitted to your department. The PC invoice application is maintained by an experienced PC DBMS development group, and PC users are satisfied with it. Now some wise guy from upstairs has mandated that your invoice information get transferred to SAP running on the AS/400 so that the corporate accounting department can project revenues.

It's time to consider some of the AS/400 PC database access products that can make the PC and AS/400 match possible. For Windows applications, the easiest and simplest solution is to take advantage of the Microsoft Open Database Connectivity (ODBC) architecture. ODBC lets you use the same queries you normally use in your existing PC application regardless of the back-end database you're connected to. Switching among DBMS back ends is as simple as changing the ODBC driver. Your desktop application code remains the same.

AS/400 ODBC drivers give you easy access to your AS/400 data from Lotus Notes, such Windows applications as spreadsheets, and a majority of Windows database packages. Several vendors supply their own ODBC solutions. For example, IBM provides ODBC solutions in its **AS/400 Client Access**, and WRQ includes them as part of its AS/400 client-access product, **Reflection for AS/400**. HiT Software also offers standalone AS/400 ODBC solutions.

To allow the ODBC drivers to talk to your AS/400, the host access connectivity router must be installed on each PC that runs the application (see "Basic Access Suites"). The router—NetSoft's SNA NS/Router, for example—must be compatible with IBM's MPTN (Multiprotocol Transport Networking).

Most ODBC packages are similar, but some come with extended features. For ex-



WALL DATA'S RUMBA ACCESS/400 95/NT FOR THE AS/400 lets you create OLE 2.0 container documents that can include AS/400 host sessions and other OLE-compliant Windows application documents.

Integrated File System (IFS) to store and retrieve PC files in the OS/400 space. Additionally, Client Access exploits AS/400 file transfer features to give you advanced options, such as the ability to use complex SQL queries to find and select files.

For database access, Client Access uses its own ODBC drivers—V2L2 (version 2, level 2)—which you can incorporate into standard Windows database applications (see AS/400 Database access). Client Access also includes Windows 95 print drivers for high-performance AS/400 AFP and SCS printers, as well as the option of printing AS/400 files to a local or LAN printer.

PROGRAMMABLE ACCESS

The Strength Of WRQ's **Reflection for the AS/400 6.0** is in its built-in Reflection Basic, WRQ's compiled programming language similar to Microsoft's popular Visual Basic. Reflection Basic gives developers a complete and familiar PC programming environment they can use to create host-access applications.

lance presentation. Using drag and drop, you can import host-based data into the other applications.

Like Attachmate's Extra! Personal Client, Rumba Office is designed as a universal client, giving you access to Digital and IBM mainframes as well as Unix systems. Wall offers an AS/400-only version of Rumba called **Rumba Access/400 95/NT**.

With all the products offering file-transfer basics and many providing DB2 for AS/400 query tools, much of the decision process boils down to the bells and whistles you want and the development options you need for your environment.

Database and Application Access

The AS/400 can be a strange box for PC folks. AS/400 operators call their hard disk space DASD, they program in something called RPG, and their system just looks funny. Yet AS/400 applications ma-

DRAQ AND DROP

Wall Data's **Rumba Access/400 for the AS/400, Version 5.0** (\$400 per user) takes advantage of Windows 95 and OLE 2.0 to provide an environment for packaging host sessions and other OLE documents into a single custom document. An OLE 2.0 container application, Rumba lets users build Notebooks of related applications. For example, a Notebook can contain a host session, Excel document, and Free-

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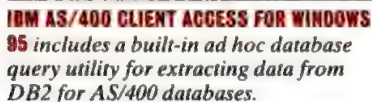
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* Industry leading 7200 RPM performance and optional SCA connector
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 **Seagate**

THE DATA TECHNOLOGY COMPANY

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ODBC isn't just for such DBMS software as Delphi and FoxPro; Visual Basic also supports ODBC drivers. Wall Data's **Rumba Access/400 95/NT for the AS/400, Version 5.0** provides Visual Basic Controls, or applets, that let you quickly add DB2 for AS/400 tables and results sets to your existing Visual Basic applications. Sybase's **PowerBuilder** application development system can also use ODBC drivers to access AS/400 database information.

Though most database and application-development programs support ODBC, generic applications—such as Word for Windows or Lotus Freelance Graphics—do not. But documents and presentations created with these applications can benefit from DB2 for AS/400 data. For example, you might want to get live data from your AS/400 during a presentation to update charts. You can extract information from your AS/400-based DB2 for AS/400 databases using Windows DDE and a specialized set of APIs. Such products as Best's **Win/400** provide a set of APIs as Windows .DLL files. You can embed API calls into a macro language, such as WordBasic, or any application language that either supports DDE and QLE calls or can make .DLLs.

API approaches are similar to the ODBC methods in that they allow developers to easily migrate from PC-based to AS/400-based data sources in PC applications.

Similarly, Wall Data's **Arpeggio for the Developer** lets you develop common queries as Arpeggio applications and then distribute them to Arpeggio users. For example, an Arpeggio application could look up late payments as part of a credit application. Wall Data also includes a graphical ad hoc querying feature as part of its Rumba Access/400 program. You can query and format result sets using a Windows graphical representation of your DB2 for AS/400 databases and tables. Links between graphical representations of tables let you create links.

ed into an existing Windows database application as easily as an ODBC driver.

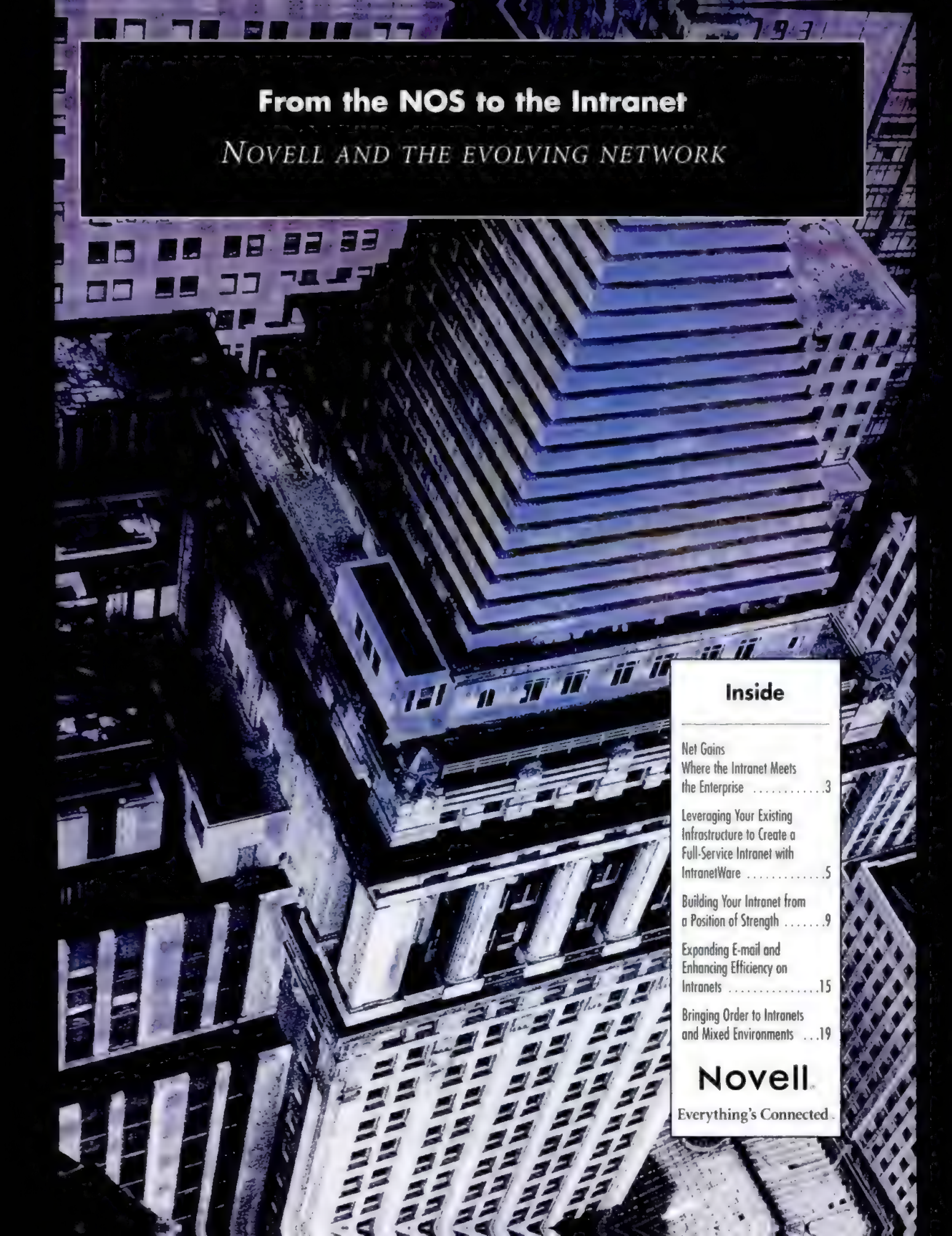
A large number of existing PC database applications are written in stalwart development systems, such as Computer Associates' Clipper for DOS.

Although Win/400 for Clipper runs with little change to most of the Clipper code, there are still some modifications. Win/400 for Clipper's Hook utility lets you identify old PC tables and databases used in the application and map new AS/400 versions. It then automatically scans the Clipper code searching and replacing the PC references with those for the AS/400.

Again, DCS offers similar capability with DCS/400 and its RDD DB2 for AS/400 implementation but does not provide the Hook migration tool.

Whether you connect your PC and AS/400 through ODBC, APIs, or ad hoc query programs, it's clear that there is strong support for the seemingly unnatural marriage of PCs and your AS/400s. □



An aerial, high-angle photograph of a city skyline. A large, modern skyscraper with a distinctive stepped or terraced top is the central focus. It is surrounded by other high-rise buildings of varying architectural styles. The image is in black and white, with a slightly grainy texture. The top of the page features a dark, semi-transparent banner containing the title text.

From the NOS to the Intranet

NOVELL AND THE EVOLVING NETWORK

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Net Gains Where the Intranet Meets the Enterprise

*LOOK CLOSELY AND IT'S EASY TO SEE THAT EXISTING NETWORKS
ARE THE URBAN SKYLINES AROUND WHICH THE INTRANET SUBURBS
GROW LIKE WILDFIRE.*

The Internet is now everywhere, but it didn't happen in a vacuum. When the Internet materialized, there were already well-developed enterprise networks. None of these were universal, but each was essential.

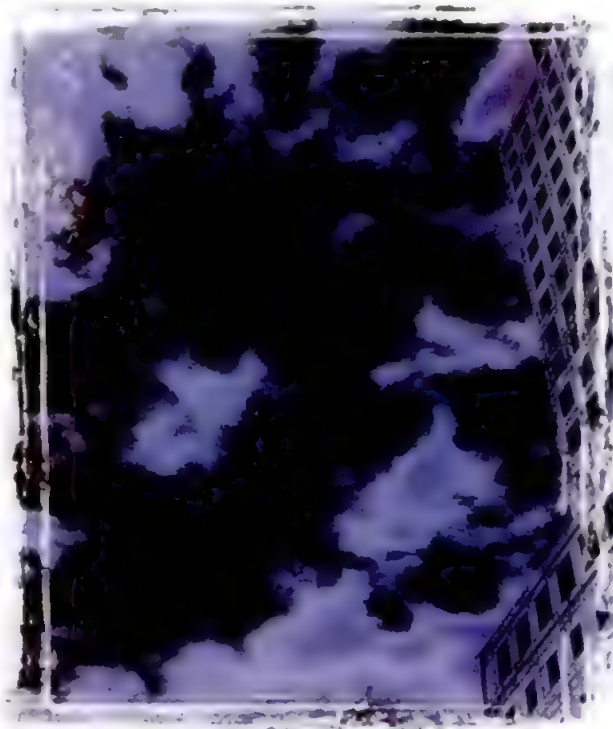
Today these LANs, WANs and other networks are still no less a part of their corporate infrastructures than the walls, floors, elevators and phones that also support corporate life.

Today, corporate systems are evolving into networks needing to attach themselves to the global Internet and access information formatted using emerging Internet standards. We call these systems *intranets*. Both the Internet and its many intranets add value to each other, much as offices and stores add value to the urban and suburban bustle that surrounds them.

At Novell we know the value intranets bring to the Internet, because much of the Internet's urban landscape was built with our products and services. In fact, more than 90% of *Fortune* 1000 companies depend on Netware to run their businesses.

Today no vendor can dominate the Internet. The Internet grew because users were in charge. It was their revolution. Some vendors had key roles, but none had control of it. And that happened because no vendor owned the standards on which the Internet was built. HTTP, FTP, GIF, JPEG and other familiar Internet standards were all in the public domain, where anybody and everybody could use them. Today the new LDAP (Lightweight Directory Access Protocol) standard gives developers greater flexibility to create Internet/intranet applications that leverage Novell Directory Services™ to open new and exciting frontiers.

This is why exclusive solutions now create more prob-



lems than they solve. So, at Novell we would rather compete than control, participate than partition, provide than prevent. We want our platform and services to be fully interoperable, so customers can buy either services or platforms confident that they work together. Eventually every vendor will commit to this ideal. Novell is committed today.

Choices, not requirements

Our industry is now between two paradigms. In the old paradigm, platforms exclusively ran their own services and applications. In the new paradigm, platform vendors offer their customers freedom of choice and interoperability—both between the platforms themselves and the services that run on them.

In the new paradigm, operating systems still com-

pete—but as choices, not requirements. Customers should be able to choose any operating system or combination of them. On top of those platforms, services should also be available on an *à la carte* basis, fully interoperable with any other service or platform. Customers should be able to choose an “all-in-one” solution, or “one-in-all.”

And no vendor is more committed to the new paradigm—and more equipped to serve customers in both paradigms—than Novell. Our key intranet services and products—IntranetWare™ for file, print and Web serving; GroupWise™ for messaging; ManageWise™ for management; and Novell Directory Services™ for directory and security—are the best of their breeds. No other vendor's intranet services offer a better combination of functionality, interoperability and support.

The choice is yours. The responsibility to provide that choice is ours. And we're taking it all the way.

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If you don't, keep reading.*

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Leveraging Your Existing Infrastructure to Create a Full-Service Intranet with IntranetWare

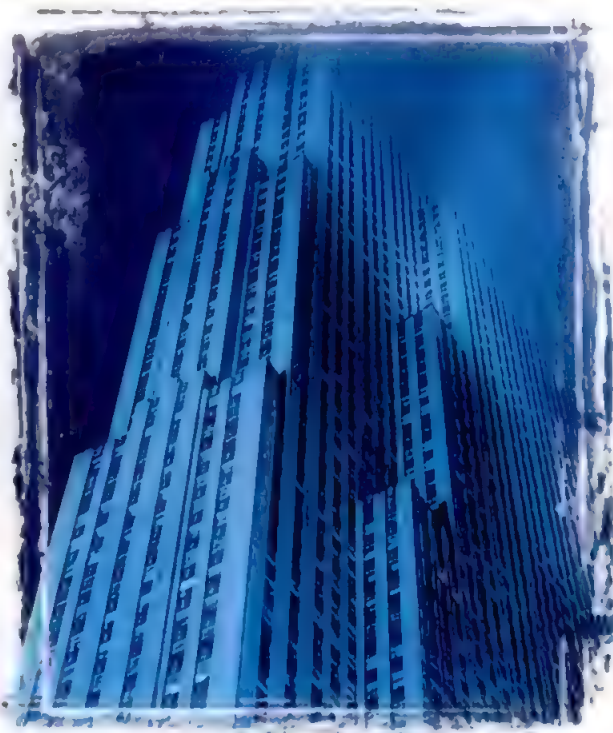
RECENTLY, THERE HAS BEEN A SWIRL OF SPECULATION IN THE PRESS, AT TRADE SHOWS AND IN OFFICES EVERYWHERE CONCERNING THE INTERNET. SOME COMPANIES MIGHT HAVE YOU BELIEVE THAT TODAY'S PCs AND DESKTOP APPLICATIONS—AND EVEN NETWORK OPERATING SYSTEMS—WON'T BE NECESSARY IN THE NEAR FUTURE WHEN NEARLY ALL THE INFORMATION, APPLICATIONS AND MESSAGING NEEDS OF THE WORLD WILL BE DELIVERED BY INTERNET/INTRANET TECHNOLOGIES.

Well, don't believe it for a millisecond. True, the Internet and intranets will cause IS solutions to evolve rapidly in the near term—they're already doing so. But the new technologies are being built on infrastructure that is already in place—infrastructure that will continue to deliver value for many years to come.

According to Forrester Research, Inc., by the year 2000, corporations will migrate away from proprietary solutions toward full-service intranets for easy connections to the outside world, access to multiple competing suppliers and lower costs. Forrester also predicts that in the same compressed time frame, intranets will mature and encompass much more than TCP/IP networks which support the Web. In general, they will offer five standards-based services: directory, E-mail, file, print and network management.

Novell already provides those five standards-based services plus two more: security and Internet technology. These are the seven core network services in IntranetWare.

Which lead to the primary point of this article: The existing network infrastructure that was built on NetWare is a fundamental structural component for full-service intranets. IntranetWare adds Internet technology, creating an intranet



that leverages your company's collective knowledge and familiarity with NetWare as well as your investment in training, hardware and software. Ever since Novell created the NOS category more than a decade ago, one release of NetWare after another has set the pace for the entire industry. And now in this new intranet age, IntranetWare again proves Novell's leadership.

The full-service intranet

IntranetWare is the most stable, secure, manageable and fully supported intranet operating system (IOS). It lets you create the full-service intranet which

will carry your corporation efficiently, cost-effectively and reliably into the future. Only with a powerful, extensible, feature-rich, services-rich IOS can intranets combine the performance capabilities, network services and overall functionality users need.

IntranetWare provides efficient access to information and all network resources regardless of where they are located on enterprise networks, intranets, or the Internet. It seamlessly accommodates organizational growth and emerging technologies. And it includes NetWare Web Server™ 2.5, the fastest Web server software on the market, which turns your current server into an Internet or intranet Web site without anyone having to



LEVERAGING YOUR EXISTING INFRASTRUCTURE

learn the UNIX OS or UNIX commands. Aside from extensibility and intranet-readiness, IntranetWare also offers 32-bit client support for desktop operating systems of all kinds. In addition, it supports standard Web browsers—the universal clients that are the interfaces to the intranet age. And IntranetWare and Novell network services such as Novell Directory Services (NDS™) integrate disparate computing and IT resources including Web servers, groupware, E-mail and messaging, telephones, security systems and distributed databases. IntranetWare and Novell network services even surround and manage other general-purpose operating systems, including UNIX and Windows NT* Server.

Improving functionality while reducing costs

Because IntranetWare includes NDS—the complete, hierarchical, object-oriented directory service—it can help you increase the productivity of everyone who administers and uses your intranet. Accessible from Netscape Navigator™ and other Web browsers, NDS lets everyone on the intranet access network resources with a single user ID and password—even on a global enterprise system with countless servers and nodes. NDS provides a single point of administration for all network resources including servers, routers, hubs, files, printers, databases, search engines, Internet addresses and users. And it works with IntranetWare to deliver an unmatched return on investment by

slashing the cost of managing computing hardware, users, applications and information.

IntranetWare is a scalable multi-processor system that's fully compliant with C-2 network security certification standards. Besides IntranetWare, only



With Novell Directory Services (NDS), network administrators and end-users can log in once and obtain a singular view of the entire network and all its resources.

NetWare 4.11 offers this level of security. This means users may safely access critical applications such as Oracle* and Sybase* databases, messaging systems and search engines across corporate networks, intranets and the Internet. Microsoft NT Server is also a government-sanctioned secure operating system, but only at the standalone workstation level. And how secure is a network if it can be breached at the server or anywhere along the wire?

According to a 1996 study conducted by IDC Research, NetWare 4.1 costs up to 28 percent less to implement than Windows NT Server. IS managers cited in the same study also said that when they upgraded to NetWare 4.1, they saw a 50-percent increase in their user-

per-server ratio. IntranetWare supports symmetrical multiprocessing for even greater performance and cost savings.

NDS and IntranetWare bring the highest levels of management, security and return on investment to intranets. But it is also important to remember file and print—the original core services which made Novell the network leader and continue to set IntranetWare apart.

Back in June of this year, *Communications Week* independently tested NetWare 4.1 SMP against NT Server 3.51. The result? "From everything we've seen in our labs, when used for file and print services, NT Server appears to be four to five times slower running on the same server than NetWare 4.1 SMP."

That's an enormous difference when you consider how much time users waste on the Internet while waiting for servers to download information.

The world's fastest Web server is part of the package

By including NetWare Web Server in IntranetWare, Novell enables organizations to easily turn NetWare servers into full-fledged intranet and/or Internet Web sites in minutes. NetWare Web Server includes Netscape Navigator, the world's most popular Web browser, plus access controls and Novell NDS

continued on page 12

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QUARTERDECK® AND NOVELL® MAKE THE CONNECTION.

Did you know Novell chose Quarterdeck's IWare Connect™ technology to serve as a critical component of its new **Intranet** solution — Novell InnerWeb Publisher™? Now, you can use the same technology for **Internet** access.*

Quarterdeck IWare Connect provides you with the powerful IP management, security, and access control capabilities you demand. One ten-minute install, and your worries are over — because Quarterdeck IWare Connect is the secure, simple to use, and easy to manage Internet solution for NetWare networks!

IP MANAGEMENT: With Quarterdeck IWare Connect, you don't need to install and configure TCP/IP on every workstation. Just one install in the NetWare server and your IP management and addressing headaches are over.

SECURITY: Quarterdeck IWare Connect's security firewall allows direct Internet access to every computer in your network, but hides each one from the outside world to render you invulnerable to break-in attempts.

ACCESS CONTROL: Quarterdeck IWare Connect enables you to selectively offer access to individual workstations according to criteria you specify — by NetWare user or group, by application type, by time; even by destination and source addresses! It also provides you with a log of Internet usage by

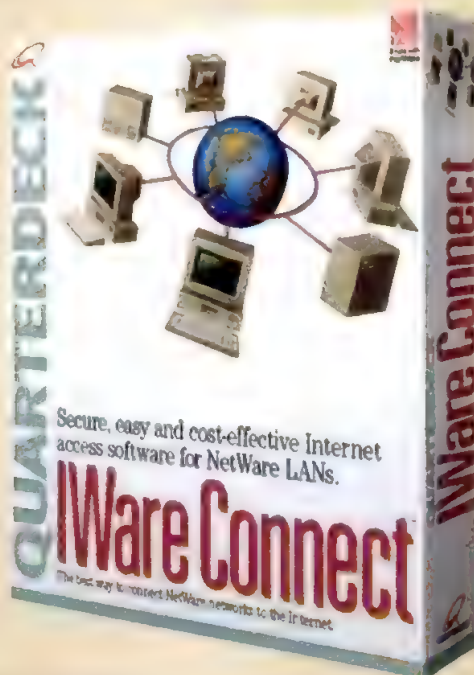
user, so that you can see patterns that'll help you plan ahead.

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Now that you know that Novell connected with Quarterdeck to plug you into the Intranet, learn more about how we can help you securely connect to the Internet. Want to read a special white paper on security or, better yet, download a trial copy of

Quarterdeck IWare Connect and see for yourself?

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Ask for code 01603. E-mail: iware@quarterdeck.com

*IWare Lite™, a customized version of IWare Connect, is bundled with Novell InnerWeb Publisher for Intranet web access.
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Building Your Intranet from a Position of Strength

*INFORMATION SYSTEMS MANAGEMENT IS LIKE POLITICS AND LOVE.
YOU HAVE TO BE VERY CAREFUL ABOUT THE DECISIONS YOU MAKE TODAY,
LEST YOU LIVE TO REGRET THEM TOMORROW.*

However, even the most cautious observer can see that intranets are a sensible, welcome improvement in enterprise computing, and that our new IntranetWare is the solid foundation for intranets large and small.

In a recent White Paper, Jamie Lewis, President of the Burton Group, summed up the promise of intranets in this way: "By applying Internet technologies to the needs of corporations, intranets have the potential to create the infrastructure for interoperable networks which will ease internal connectivity problems that isolate information. The intranet will also make connecting to the global Internet a matter of network design, not a complex technology problem."

Lewis goes on to say that the intranet is the most important development since the network operating system. This is clearly a defensible position. But before progressing any further down this old-fashioned, pulp-enabled page, let's define the term intranet because it's evolving all the time. Intranet, according to Novell, is an internal corporate network enhanced with Internet technologies and secured against external access. It has three basic components: 1) a Local Area Network (LAN), 2) a Web server, and 3) networked computers equipped with Web browsers. The Web server resides on a LAN server, which users



access via Web browsers. Although you can use Novell Internet technologies to build an intranet on virtually any network operating system, the company recommends (no surprise!) IntranetWare. It's the internetwork operating system that has no equal when it comes to performance, security, extensibility and manageability.

InnerWeb Publisher: the ultimate intranet publishing solution

The most complete, cost-effective solution of its kind is the Novell InnerWeb Publisher™. Simply install it on your NetWare network and, without

anyone having to learn new languages or protocols, your company is fully Web-enabled within minutes—with everything you need to publish internal Web documents.

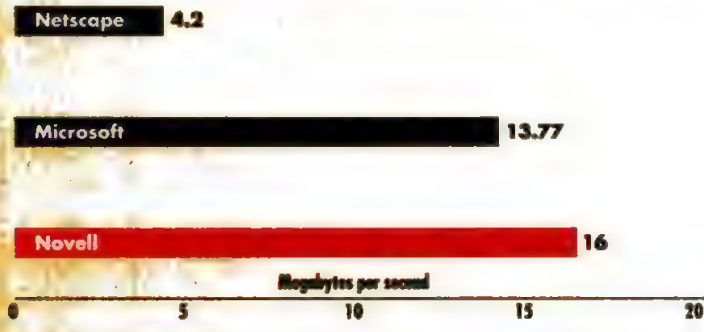
Novell InnerWeb Publisher includes everything you'll find in NetWare Web Server 2.5. It also includes a runtime version of NetWare 4.11, which makes it easy to implement your intranet on a standalone server. By so doing, you avoid any performance issues that could crop up if you install your Web server on the same server that's running file, print, messaging and other mission-critical services. In addition, this approach provides an extra firewall for added security.

And Novell InnerWeb Publisher contains the Netscape

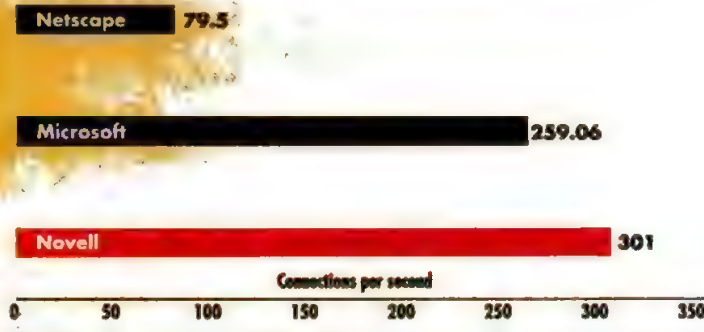


BUILDING YOUR INTRANET FROM A POSITION OF STRENGTH

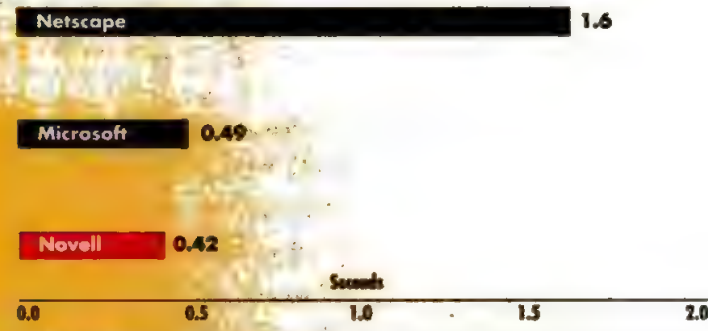
Web Server Throughput Higher numbers = better performance



Web Server Connections Higher numbers = better performance



Web Server Response Time Lower numbers = better performance



Source: Numbers by Stille Consulting

Navigator Web browser and Quarterdeck's® IWare Lite™, an outstanding IPX-to-IP translator. Because of IWare Lite, IS managers do not have to configure TCP/IP on every workstation. The Novell InnerWeb Publisher approach is much less time-consuming and less expensive than either Microsoft or Netscape solutions, which require configuring workstations for intranet use by installing and managing TCP/IP stacks on every desktop.

Like all Novell intranet solutions, InnerWeb Publisher is a Java™ environment. It can store Java applets on NetWare Web Server as well as executing these applets within the Java Virtual Machine™ that has been integrated into the Web browser. Intranet customization with innovative new applications as well as integration of existing applications can be quickly accomplished; legacy databases, for example, can easily be upgraded to Web-awareness.

Novell InnerWeb Publisher also features HoTMetal Light™ from SoftQuad®, an outstanding Web authoring toolset. It features templates and step-by-step instructions that make Web page construction painless for both the Webmaster and the novice.

And, finally, InnerWeb Publisher supports Symmetric Multiprocessing

continued on page 12

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With an installed base of over three million users, Seagate Software backup solutions will satisfy the data protection demands at all levels of the organization. Our award-winning solutions include DOS, OS/2, Windows 95, Windows NT and of course, NetWare - from the desktop to the enterprise, for networks of any size and complexity.

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continued from page 10

(SMP) and System Fault Tolerance III™ (SFT III™)—advanced features of IntranetWare. The former enables companies to scale NetWare Web Server to more microprocessors as performance needs grow; the latter provides the level of stability that can handle 24 x 7 uptime requirements.

One big global intranet is now possible

Internet-related downtime fears, access problems and service concerns can all be avoided with a new global service called NetWare Connect Services™. It combines the quality, performance and reliability of the AT&T network and other global carriers

with the ease-of-use, security and connectivity of Novell's NetWare and IntranetWare. Based on NDS, it connects one intranet with another anywhere, anytime, with absolute hackerproof security. No other solution is so airtight. And you don't have to build and maintain WAN links, either. NetWare Connect Services simply provides the data dial tone you need when you need it. Many Fortune 500 companies are discovering the benefits of NetWare Connect Services daily—as they share sensitive information with branch offices, manufacturing facilities, remote sales forces and suppliers—with the certainty that their data will be delivered safely.

Making the right decision

If your company already uses NetWare, you're in great shape. You can upgrade to IntranetWare and take advantage of this high-performance, stable, reliable, extensible, manageable and familiar, full-service intranet platform. And you can build your intranet knowing you have a powerful foundation that will put you in good stead. If you are not currently using NetWare but are looking to build an intranet, by all means proceed with caution. With careful consideration, chances are excellent you'll choose IntranetWare and Novell's best-of-breed network services as the infrastructure components for your intranet solution.

continued from page 6

Authentication for secure access and management. NetWare Web Server also supports NetWare Symmetrical Multiprocessing™ (SMP) and NetWare System Fault Tolerance III, two features built into IntranetWare that respectively provide unmatched performance and security. No other intranet operating system/Web server combination is as stable and secure as IntranetWare and its NetWare Web Server. And no other combination allows faster access to a corporation's data on the intranet, and enables more users to simultaneously access the data at any one time. In fact, according to independent tests, NetWare Web Server outperformed Microsoft's Internet Information Server* (IIS) and Netscape's

Communications Server by as much as 400 percent.†

Getting your intranet up and running

To create an intranet server, simply load IntranetWare and its IntranetWare Web Server, then provide users with the included Netscape Navigator browser. Want to add Internet access? No problem. IntranetWare makes connection to the Internet easy and inexpensive. You can run IP or IPX protocols, because IntranetWare provides an IPX/SPX-to-IP gateway. And to simplify configuration and administration, IntranetWare requires just one TCP/IP stack (and IP address) at the server, instead of at every desktop.

IntranetWare provides seamless Internet access regardless of desktop platform or network topology. It pro-

vides efficient, cost-effective connectivity for branch office intranets. Equally important, its integration with NDS lets you administer user access rights—local or global—from one central point.

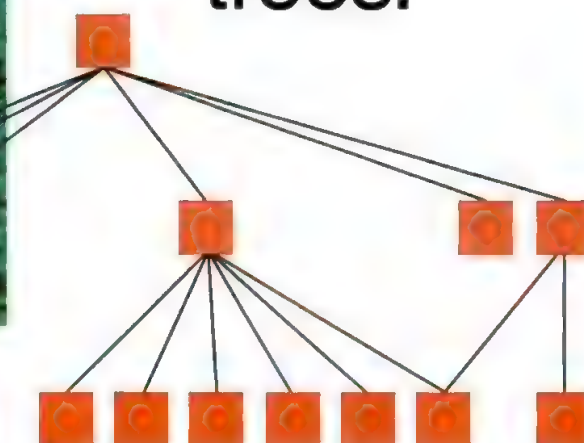
The Internet technologies and other core network services from Novell that define the full-service intranet are already in widespread use. So, go ahead and assess the field of next-generation intranet operating systems carefully. You'll find that no matter how things change, one thing stays the same: Novell is the company that provides the best enterprise network—and intranet—solutions.

For more information, fill out the enclosed card
or call 1-800-200-8105.

†Source: Shiloh Consulting /Haynes and Company Performance Benchmarks, 3/96



Until now,
**only a higher
power**
could maintain
strong, healthy
trees.



If you're using Novell's® NetWare Directory Services™ (NDS™), you need DS Expert™ to keep your tree strong and healthy.

DS Expert is the first and only centralized network management tool for NetWare 4.1 networks that helps you monitor, troubleshoot, and optimize NDS in real-time.

DS Expert constantly monitors your NDS environment, alerting you immediately to any problems. It even locates and identifies the problem, giving you an edge in troubleshooting and getting the network back online.

What's more, DS Expert can help validate your NDS design. You can track NDS statistics by server and use this information to optimize the NDS environment specifically for your network.

Need proof? Call NetPro today for a copy of our White Paper, NDS Management with DS Expert, or visit NetPro on the World Wide Web to try DS Expert for yourself.

Of course, you could maintain your NDS network tree without DS Expert...

But, you might need some divine intervention.



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Expanding E-mail and Enhancing Efficiency on Intranets

*CLOSED, PROPRIETARY ELECTRONIC COMMUNICATIONS SYSTEMS
ARE GREAT FOR MONKS OR SPYMASTERS,
BUT THEY DON'T MAKE MUCH SENSE FOR THE REST OF US.*

As business people continue to forge links farther and farther outside the boundaries of their departments and companies, the demand grows for open systems—which is why intranets are so incredibly popular. HTML is being universally embraced because it's an open protocol that enables everyone—regardless of platform preferences or system constraints—to communicate and work together. Novell GroupWise™ has quietly risen through the ranks of E-mail and messaging programs for the same reason—because it's an open, cross-platform solution that enables people to make the most of the systems they have today and will have tomorrow. GroupWise users presently number well over six million world-wide.

A better intranet E-Mail environment

GroupWise with its Universal Mailbox is in every way a better intranet/Internet application than any 'net-based E-mail system. And with the introduction of GroupWise 5, it is now becoming the premier collaborative intranet application. GroupWise 5 brings the open standards of the Internet to the business LAN and corporate WAN, connecting you to the people and information you need whether they're down the hall or on the other side of the world. It expands the definition of E-mail to encompass



full groupware solutions, including cross-platform messaging, document management, workflow and scheduling. Feature for feature, Lotus® Notes™ and Microsoft® Exchange™ can't compete.

GroupWise WebAccess for GroupWise 5 will let you place documents in a shared folder on an intranet and assign rights to it—who can read it or modify it, for example. So, you can post and manage documents publicly without giving away the store. The alternative can be chaos and the potential loss of sensitive data. GroupWise 5 is the only system

offering this level of document management.

Something else that stands out about GroupWise 5 is that its architecture is based on TCP/IP—the Internet protocol standard. As a result, all your messages can be transmitted securely across WAN links and accessed anytime from anywhere on the planet. You may choose conventional means of access—your desktop or laptop PC, for example. Or use any touch-tone phone. GroupWise 5 reads your messages back to you and can even route faxes at your request. When you add GroupWise WebAccess to your system, you can retrieve your messages over the Internet or company intranet from any standard Web browser. Users can read and send GroupWise mail, access their



calendars and set appointments, check the status of outgoing messages, and participate in document management, workflow and more. GroupWise 5 even allows users to send URL links via E-mail that, when opened, take the user right to the referenced home page.

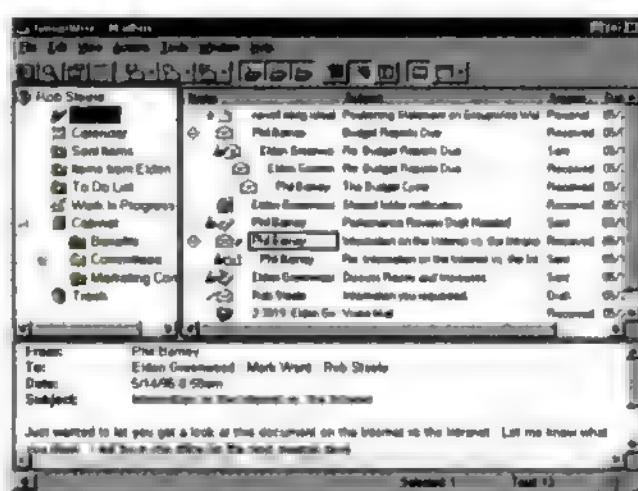
Duplication of effort is a thing of the past

For administrators, GroupWise 5 unifies the management process for both your network operating system and messaging system. By taking advantage of Novell Directory Services (NDS) and NWAdmin™—both of which are familiar management components for NetWare and IntranetWare administrators—assigning user addresses is accomplished in one step for both systems. What's more, both systems can be managed using ManageWise.

Automating the workflow process

Workflow is another area where GroupWise 5 shines. The process of doing business often entails several people adding signatures and other input to various forms. And some workers can become walking bottlenecks. But GroupWise 5 makes the whole workflow process easy and automatic. Let's say, for example, that you decide to visit a vendor in Detroit. Using GroupWise 5, you fill out an electronic travel request form and send it to your manager. When the manager approves it, GroupWise kicks into high gear. It sends the approved travel request automatically to the travel department, which issues you a plane ticket. Travel

sends the request to Accounting, where the price of the plane ticket is deducted from your travel budget and an electronic version of your itinerary is routed to your administrative assistant or office manager. At any time in the process, you can easily check the status of your request and nudge



The GroupWise 5 Universal Mailbox is where users receive, send, organize and manage all communications and information.

people along if their response is anything less than swift. And it's all as easy to accomplish as sending E-mail.

The beauty of a mailbox

But the real magic of GroupWise 5 for users is in the technology behind its Universal Mailbox. It redefines electronic communications to include not only E-mail (from other GroupWise users, other E-mail systems and the Internet) but also voice mail, fax messages, task assignments, scheduling notices—even pager messages. The upshot is that you can access all your messages from one graphical interface, elegantly organized to your specifications. Now, everyone from the mailroom clerk to the CEO can quit bouncing back and forth between all the message sources in the workplace

today and get back to business. The Universal Mailbox makes it possible, and requires no additional training.

Support for open standards and developers

GroupWise 5 is the fastest, easiest path to a full-function intranet. Customizing and enhancing your intranet's messaging and groupware functionality is simple, thanks to the support of open standards provided by GroupWise. These standards include IMAP, POP3 and SMTP MIME. GroupWise 5 also supports Java and ActiveX*. Applications developed in these environments run in the GroupWise environment without modification.

For businesses of all kinds, GroupWise is the ideal intranet choice. For users who live in their browsers, GroupWise 5 enables document searches, scheduling of meetings, task assignments and messaging via the Internet. For users partial to a desktop client such as Windows 95, complete GroupWise functionality—including sending E-mail and attachments—is an icon-click away.

Intranets need the addition of stable, mature technologies: open solutions instead of obstacles. In terms of messaging, the fully optimized intranet must include outstanding cross-platform E-mail, workflow, task management and scheduling. And—no surprise—that describes GroupWise 5.

For more information, fill out the enclosed card
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Find out how you can build your intranet with innovative products from Novell.
To receive more information, simply answer the following questions and drop this card in the mail.
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☐ NetWare 3 ☐ NetWare 4 ☐ NT Server
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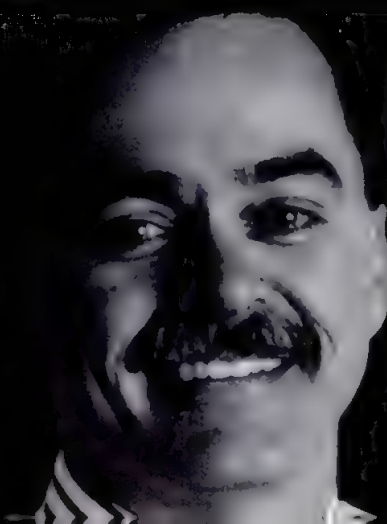
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BUILT ON SCALABLE

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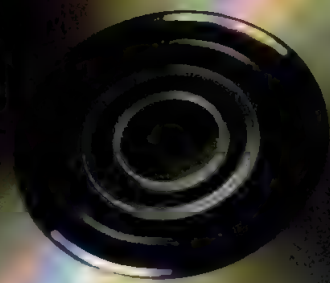
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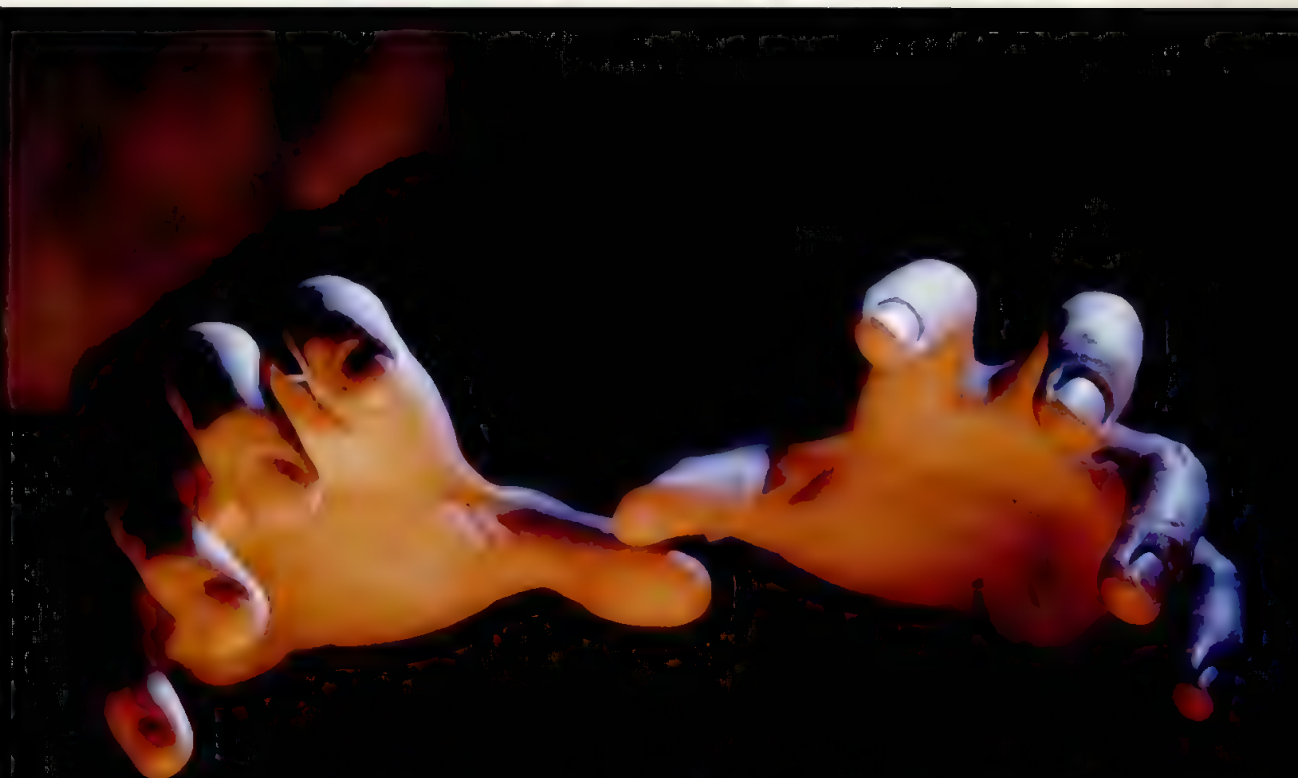


**"FOR SCALABILITY, PERFORMANCE AND
SHEER VALUE, NOTHING ADDS UP
LIKE SCALABLE SQL."**

*Vern Strong, Vice President of Systems Development,
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Bringing Order to Intranets and Mixed Environments

*"IT IS THE FUNCTION OF CREATIVE MAN TO PERCEIVE
AND TO CONNECT THE SEEMINGLY UNCONNECTED."*

~WILLIAM PLOMMER

People have dramatically different views on diversity. Some fear it, while others use new perspectives and viewpoints as a springboard for creating meaningful change. The Internet is a major force influencing cultures throughout the world. Likewise, intranets are changing the way people view information access and publishing in corporate information systems.

So how much diversity is too much? It's a question that many IS managers grapple with daily. Clearly, people are more productive when they use their favorite desktop environments, applications and tools.

Therefore, the key is not to limit diversity, but to make information, systems and applications interoperable and manageable. This is what Novell does better than anyone else—with solutions that leverage your existing IT investments, while taking advantage of emerging intranets.

Complete, proactive management for mixed NetWare and Windows NT Server networks

Few statements are cut and dried in today's complex world, but here's one that's impossible to dispute: No one has as much experience in building and managing your heterogeneous networks as Novell. Intranets are a natural extension of the NetWare networks that the world's top businesses rely on every day. And



they share more in common than you might think—including management.

ManageWise™ is today's only comprehensive, integrated management solution that lets you manage and optimize your heterogeneous network—including NetWare, IntranetWare and Windows NT® Servers. It integrates network traffic analysis, automated network hardware and software inventory, remote control, SNMP device management, virus protection and software management. Naturally it's from Novell, so it also manages the broadest array of desktops, too: DOS, Macintosh, OS/2, OS/2 WARP,

Windows and Windows 95—with Windows NT client support coming later this year.

So what does all of this have to do with your intranet? Plenty. For starters, ManageWise detects over 400 network problems, automatically fixing many and recommending solutions for others—before problems have a chance to become serious. With ManageWise, you'll always know CPU utilization, packet throughput, and other critical performance information to ensure that your intranet server doesn't bog down. It works with Novell Directory Services (NDS), the world's most trusted global directory. It also automatically discovers and tracks all the servers, equipment and applications on your network. Such reli-



ability helps you prevent costly downtime while significantly reducing the expense of managing your system.

Broad-based support

Thanks to overwhelming industry support, you build upon ManageWise to match your system's exact needs with over 100 third-party, snap-in modules. These modules integrate management capabilities from the leading providers of hubs, switches, routers, server hardware and much more. In fact, one add-on package automatically notifies your pager if your network is headed for a problem—well before the network has a chance to go down (or your voice mail has a chance to fill up).

Intranets and Internet technologies are based upon open heterogeneous access. Which is why ManageWise supports open industry standards. For example, SNMP and RMON support lets you integrate ManageWise information with enterprise consoles such as Hewlett-Packard's OpenView* for UNIX*, Sun Microsystems's SunNet Manager* and IBM's SystemView* for AIX.

Novell Directory Services: bringing it all together

Perhaps the most strategic management decision of all involves the type of directory your intranet management solution supports. The Burton Group, a leading network research firm, describes directory services as "the logical place at which network services, applications and people meet, find one another and act."

Novell Directory Services sur-

rounds and assimilates any technology on your network. In other words, with NDS, every user, device, database and application on your intranet is enclosed in a security wrapper—so only authorized users access authorized resources. And they can find them anywhere across your

Reduce Your Cost of Ownership Today and Tomorrow

ManageWise provides the best value of any solution on the market, delivering a significant return on investment while reducing the cost of maintaining networks. According to International Data Corp. (IDC-1996), ManageWise:

- pays for itself through cost savings in only one month;
- saves approximately \$1,000 per server per year in management costs;
- reduces network downtime by 50 percent;
- allows a network staff person to support 25 percent more desktops and 33 percent more servers, while decreasing travel costs to remote sites by 50 percent; and
- operates efficiently over low-cost telephone lines, providing cost-effective management from remote sites.

distributed intranet without knowing where to look.

For example, anyone with a frequent-flyer card knows that when they really need something, it's no doubt back at their office. Documents, applications, decision-support data, you name it. With NDS, authorized users can log onto your private intranet from anywhere via dial-up connections or the Internet. Let's say that you're traveling but forgot to bring a

specific application. The NetWare Application Launcher,TM a new feature of IntranetWare, works with NDS to find the applications and distribute them—right to your hotel room, if need be.

Another real productivity zapper is managing disparate IT infrastructures. Today, with NDS, you can easily manage the entire infrastructure and services on your intranet, along with GroupWise and Oracle databases, as an integrated system. Soon, any system, database or information will be easily managed regardless of where it's located, saving countless hours of redundant administration.

Scalable management

The Internet is living proof that it's possible to build an extremely large network. Unfortunately, it also reinforces the need for a scalable directory and management services.

ManageWise provides unmatched scalability through integrated support for NDS. In fact, anyone considering building an intranet should heed the advice of Forrester Research. In its *Computing Strategy Service Report* (June 26, 1996), Forrester states: "For the next few years, CIOs should leverage NetWare's enterprise directory. For companies that are rationalizing network administration and management costs, NDS is the only viable alternative today."

Managing change: a new way of looking at Web browsers

As the definition of networking continues to broaden, so, too, must the tools to manage global intranets. That's why

continued on page 22

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continued from page 20

ManageWise will soon become platform independent—supporting Java technology and the Internet infrastructure. As a result, you'll easily manage desktops, systems and devices, regardless of what platform they run on or where they're located across private and public intranets.

Everything that you can now do with ManageWise, you'll soon do using your Web browser and Java applets—from any intranet or Internet location.

Should you bother to manage your intranet?

Obviously, someone needs to. Although thanks to ManageWise, they don't need

to be on-site. ManageWise employs intelligent agents which monitor the network, so that servers at remote sites don't require constant communication with the central console, or dedicated phone lines. This fact, coupled with the promise of cross-platform management services via Internet access, opens countless opportunities for remote management and the outsourcing of management services. After all, many small businesses don't need a full-time network administrator; medium-sized organizations may not want to maintain a help desk; and larger companies with specialized needs,

such as automated manufacturing facilities, may opt for an outside technical service provider.

The future is wide open

As traditional networking and Internet technologies rapidly merge into hybrid intranets, rest assured that Novell will lead the way with management solutions that preserve your IT investments, while making available all the power and diversity that the future is certain to offer.

For more information, fill out the enclosed card
or call 1-800-200-8105.

How ManageWise Stacks Up Against the Competition

ManageWise is the only comprehensive, integrated management solution on the market today that lets you successfully manage and optimize your heterogeneous networking environment. It offers IntranetWare and Windows NT Server management; desktop management; network analysis; automated network inventory; remote control; software management and virus prevention. Through this end-to-end manage-

ment, ManageWise increases network reliability and performance—greatly improving user productivity and your business operations.

It's easy to see why a survey conducted by the Gallup Organization (September, 1995) found ManageWise to be the first choice for IS managers seeking a management solution.

Competitive Advantages: Comprehensive management capabilities integrated into one package

- Unified IntranetWare and NT Server management
- Software management
- Historical performance trending
- Preserves and leverages existing systems
- Scalable solution for small to large networks
- More than 100 third-party, snap-in products available
- Standards-based integration with enterprise consoles
- Easy, low-cost integration with remote sites
- Delivers a best-of-breed management solution that is tightly integrated with IntranetWare
- Superior technology backed up by the leader in networking

Competitive Features

	Virus Protection	Remote Control	Workstation Inventory	NetWare 3 Server Agent	IntranetWare Server Agent	Includes SNMP Agent Platform	NT Server Agent	Software Agent	Pocket Capture and Download	SNMP Support	Automatic Network Mapping	Integrated In-call Open Enterprise Architecture	Scalable Pricing
ManageWise	•	•	•	•	•	•	•	•	•	•	•	•	•
LANDesk Management Suite™ (Intel®)	•	•	•	•	•	•	•	•	•	•	•	•	•
Systems Management Server™ (Microsoft®)	•	•	•	•	•	•	•	•	•	•	•	•	•
Norton Administrator Suite™ (Symantec®)	•	•	•	•	•	•	•	•	•	•	•	•	•
Brightworks™ (McAfee®)	•	•	•	•	•	•	•	•	•	•	•	•	•

■ Future version ▼ Scored desktop but not the server

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Creating secure, dynamic Intranet applications for your NetWare file server has never been so easy. All you need is NetBasic WebPro which includes: Novell's NetWare Web Server, HiTecSoft's Secure Web Server, the Integrated Development Environment, and a database module.

NetBasic generates dynamic HTML, so each time a user requests information, scripts dynamically build a new page and the information is automatically updated. Now maintaining Web pages is no longer a burden.

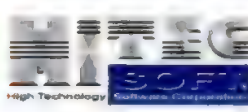
NetBasic WebPro's IDE is a full-featured graphic development environment with powerful windows features including drag-and-drop, context-sensitive help, and many pre-written scripts and utilities. The Visual Basic style syntax makes it easy to develop

intranet or internet-ready server applications and utilities that run on NetWare file servers.

With the Database module you can create NetWare server applications that access databases to simplify gathering, storing, and distributing data on your intranet or internet. And NetBasic WebPro also includes a secure Web server with RSA encryption and SSL Technology keeping all your sensitive information confidential.

Yes, now there is an easy way to author intranet or internet applications for your NetWare server.

Unless, of course, you'd rather program it all in C.



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With real-time virus protection.
And isn't that, in all fairness, what
your network deserves?

For a free white paper on Cheyenne's performance advantage in virus-free backup, as well as a free live trial, visit us at www.cheyenne.com/virusfree.html. Or call 1-800-991-4438.

Backup and Antivirus Software Performance Comparisons

Backup Software	Antivirus Software		
	Cheyenne InocuLAN 4	Symantec Norton WTK 2.02	McAfee NetShield 2.32
Cheyenne ARCserve 6	92.3	68.1	64.5
Legato Networker 4	56.7	52.8	53.7
Seagate Backup Exec 7	66.1	65.0	59.6

Test measures backup throughput in megabytes per minute. Higher results are better.



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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

CORPORATE FAX SOLUTIONS

Faxing Jumps on the Internet Bandwagon

By Sean Gonzalez

Corporations are continually faced with enormous telephone bills—that's a fact. The culprits could be a few employees calling Mom on company time, but the true cause may be the company fax machine. Most corporations send out hundreds or even thousands of

faxes every day. And that can get expensive, especially with international calls running as high as \$6 per minute.

Companies such as Brooktrout Technology and NetXchange Communications have been exploring the use of leased lines, LANs and WANs, and even the Internet to send faxes,

thereby slashing fax costs. The end results of this research are Brooktrout's IP/FaxRouter and NetXchange's Internet Fax Exchange.

Besides cost savings, these products also deliver true fax routing capabilities. If a given path becomes unavailable or congested, these products can

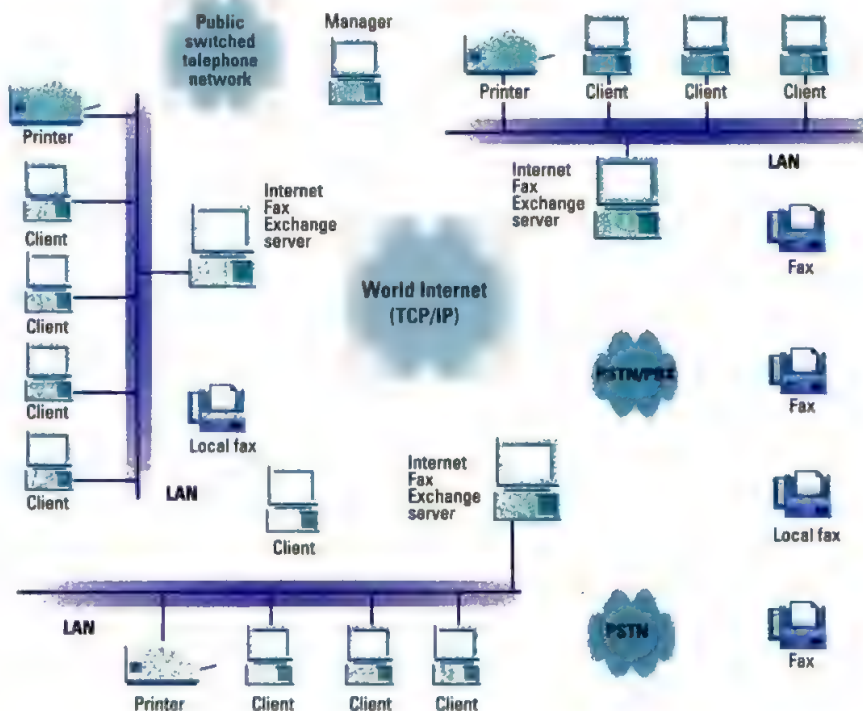
route your faxes through alternate paths to ensure delivery. Internet Fax Exchange takes this process a step further by letting you define which of the available paths is least expensive during different times of the day.

If you have a large network, though, your management costs may be tremendous as well. Both products include more-than-competent management tools, but Internet Fax Exchange's SNMP-based real-time monitoring and network auto-discovery capabilities make management much easier.

Also, both products can send and receive faxes from standard fax machines. This means user training costs are minimal, and you don't have to toss out any of your existing equipment.

Internet Fax Exchange Explained

Internet Fax Exchange accepts faxes from either standard fax machines or Microsoft Windows 95 clients running the Internet Fax Exchange client software. PCs send faxes either through the print command or through the Microsoft messaging client. Each fax is then queued to an Internet Fax Exchange server, which determines the most cost-efficient way to deliver the fax. Because telephone networks can be used with this product, you are not limited to computer (IP-based) networks for your faxes; you can use PBX, leased-line, or frame-relay networks. Internet Fax Exchange is then responsible for finding the optimum path to deliver each fax transmission based on internal routing tables.



NetXchange Communications Internet Fax Exchange

If you're frustrated by the charges your company is paying each month to fax documents around the world, or even just to a remote site, then consider NetXchange Communications' Internet Fax Exchange, Version 1.190 (\$2,400 for 2 server ports and 15 client stations). It is one of the first products to use leased lines and the Internet intelligently for dramatically reducing the cost of faxes. This product is a software-only faxing solution that is easy to setup and configure. Its intelligent fax-routing software ensures that large and small corporations, as well as fax service bureaus, always use the least-expensive delivery path.

Whenever possible, Internet Fax Exchange uses private

NETWORK EDITION

First Looks

LAN/WAN lines and the Internet to deliver faxes. And by essentially treating the fax machine as an external fax card, it routes standard telephone lines and fax machines through your PBX to the Internet Fax Exchange server or connects them directly to the server.

Internet Fax Exchange determines the most cost-efficient delivery route using a least-cost routing algorithm. The site administrator defines static routing, which uses private LANs; prefix routing, which is based on area code; and exchange rates to exploit time-zone differences that can be used to obtain lower delivery rates. If regular phone lines need to be used, Internet Fax Exchange will deliver your fax at a time when line charges are lowest, unless you have specified immediate fax delivery.

Internet Fax Exchange comes with both client and server software. The server software runs on a Microsoft Windows NT server or workstation equipped with a Gammalink or a Pure Data SatisFAXtion fax board.

Internet Fax Exchange also includes SNMP-based server monitoring software—Xchange View—which allows administrators to manage all corporate Internet Fax Exchange servers from HP OpenView-enabled PCs. NetXchange's Xchange View is an RMON-like application that by using its special SNMP MIB lets you manage a very large faxing infrastructure. You must have SNMP installed and configured, however, before you can use Xchange View.

The Internet Fax Exchange client software runs on Windows 95 systems equipped with TCP/IP or NetBEUI for Internet-based faxing. Because faxing is done through Windows 95's Exchange client, the print command in any Windows 95 application, or fax clients, the software doesn't add icons to your desktop or the Start Menu. You have to reconfigure the Microsoft fax service manually to use Internet Fax Exchange.

Internet Fax Exchange will

accept faxes from PCs running the client software or from standard fax machines that have the phone line routed through the Internet Fax Exchange server; the server accepts the fax and routes it as it would a fax originating from a Windows 95 client. This means you can reduce your faxing costs without throwing

dialog protocol; RTMP (Real-Time Messaging Protocol), another NetXchange protocol; and SNMP. SFTP is similar to SMTP; its goal is to simplify and standardize fax exchange protocols on the Internet.

Resource Reservation Protocol (RSVP) focuses on real-time communications and band-

Internet Fax Exchange is one of the first products to use leased lines and the Internet to reduce fax costs dramatically.

out your old machines or retraining all your users.

Users can send faxes from the print command in Windows 95 applications or through the Microsoft messaging client. The fax is then queued to an Internet Fax Exchange server that locates the most cost-efficient route for delivery. The fax can go to either a destination fax machine or another Internet Fax Exchange server, which sends it to a fax machine. Currently, the product can't deliver to PCs in any format other than fax, but a fax-delivery mechanism that works through the Microsoft e-mail client should be available soon.

NetXchange devised methods to do this sending and routing. Internet Fax Exchange server uses three protocols: SFTP (Simple Fax Transfer Protocol), NetXchange's emerging server

width-availability issues on the Internet. RTMP is NetXchange's way of addressing Internet Fax Exchange's requirement for real-time transmission of faxes from the server to its destination peer. Internet Fax Exchange servers can be interconnected via private LANs/WANs or the Internet, and they can reach fax machines directly attached to the Internet Fax Exchange server or through regular telephone lines.

Internet Fax Exchange has a few other neat features. If enabled on the server, it provides user authentication, and it can bill faxes to specific user accounts. Users can bill each fax sent to specific accounts as defined in the Internet Fax Exchange server's client database. Usage reports can then be exported to other applications.

Internet Fax Exchange, Version 1.190. List price: 2 server ports and 15 client stations, \$2,400; site license, \$27,500. NetXchange Communications Ltd., San Francisco; 415-346-4131; fax, 415-346-2430; www.ntxc.com. Circle 956 on reader service card.

Brooktrout Technology Inc.

IP/Fax Router

If you don't want to toss out your fax machines but you do want to cut down the related phone bills, Brooktrout Technology has recently introduced a hardware faxing solution to help you do just that—the IP/Fax Router (\$5995 per router; \$1,995 per network for management software). IP/Fax Router allows you to reduce faxing costs by intelligently using the Internet and leased lines. And it's essentially transparent to users.

IP/Fax Router works by connecting to standard fax machines and then allowing routing tables to determine whether to use internal, private, or dedicated lines to send the fax. Unlike Internet Fax Exchange, the IP/Fax Router works only with your standard fax machines; it is not a client/server solution. Brooktrout does have an API in the works, however, that will allow direct PC-to-router connectivity.

In addition, IP/Fax Router isn't as intelligent as Internet Fax Exchange in its routing. IP/Fax Router either defers faxing for times when rates are lower or uses internal TCP/IP and telephone networks. Internet Fax Exchange, on the other hand, uses its least-cost routing algorithm and proprietary protocols to determine the most cost-efficient path for the fax.

That being said, the IP/Fax Router offers outstanding management tools, particularly for small-to-medium-size networks. The Configuration Network Management Software, or CNMS, lets you tailor the IP/Fax Router to your site's specific needs and generates usage reports. But its lack of large-site management tools will some-

CROSSTALK



Leon Erlanger

“These fax servers can make IS folks into corporate heroes, Frank. If an organization sends out more than a hundred faxes a month, then using a centralized fax server saves dollars and makes sense. But they don't do much for the people receiving incoming faxes.”

“But if the fax server stumbles, Leon, the heroes become zeroes. This is classic burden shifting. Faxing becomes easy for everyone, but managing the fax server becomes a high risk job for IS. Smart buyers will carefully examine the fax server management strategies these companies offer and look for the best fit.”



Frank Derfler

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times force you to do a lot of repetitive work. For example, IP/Fax Router requires manual registration of all routers. Internet Fax Exchange uses SNMP to discover all the IFE servers on the LAN, which means you don't need to register them with the software vendor. In determining the number of routers you need for your network, you can either play telephony tricks to redirect all your fax machines to an IP/Fax Router or connect a router to each fax machine.

The IP/Fax Router is a small box that installs with the rest of your communications gear, and we found setup straightforward. Each IP/Fax Router has four ports: three to attach conventional analog telephone lines and one to attach a fax machine. You configure the telephone number for each of the analog ports, as well as the IP/Fax Router's IP address. The IP/Fax Router also has an internal 500MB hard disk to store faxes until they can be delivered.

To perform basic configuration and diagnostics, you access the IP/Fax Router's console through an RS-232 connector. Once the router is set up and configured, CNMS is the main tool you use to interact with your network's IP/Fax routers. From CNMS, you can download software revisions, define each IP/Fax Router's characteristics, get status information, define call-deferral periods, auto-route calls to specific numbers, and get data for usage reports.

CNMS also alerts you to problems. Each router reports its status to CNMS once every 30 minutes. If an IP/Fax Router reports a problem or fails to report its status, CNMS alerts you. You can then use the CNMS status log to get detailed information on the problem.

Each IP/Fax Router keeps extensive logs. From these, CNMS can build usage and accounting reports, and the log data can be exported in ASCII format to be used by other applications.

Complete account-based faxing logs are kept with the Ac-

count Data Management System (ADMS), which is an additional \$1,995. The IP/Fax Router has account management disabled by default; when enabled it requires entering a seven-digit account number before the destination fax number. The additional account information is logged and can be used to generate per-account reports.

IP/Fax Router also supports speed dialing and broadcast lists. To deliver broadcast faxes, IP/Fax Router intelligently routes a single copy of the fax to

each IP/Fax Router that then makes one or many fax calls to deliver the fax to all recipients. You can also define dialing prefixes, enable per-line access passwords, and set call-deferral periods for lower rates. IP/Fax Router's auto-route feature lets you reroute faxes coming in at each fax line to a different number. For example, if your company CEO spends time in different cities, you can set up IP/Fax Router to deliver faxes to the appropriate city, and senders need know only one fax number.

Except when line-access passwords or accounts are enabled, IP/Fax Router is transparent to users. But when the IP/Fax Router is connected to a PBX, users will have to dial the PBX extension first, wait for a second dial tone, and then dial the destination fax number.

IP/Fax Router. List price: Per router, \$5,995; software for each network, \$1,995. Brooktrout Technology Inc., Needham, MA; 617-449-4100; fax, 617-449-9009. www.brooktrout.com. Circle 969 on reader service card.

CONFERRING SOFTWARE

Real Collaboration in RealTime

By Tony Pompili

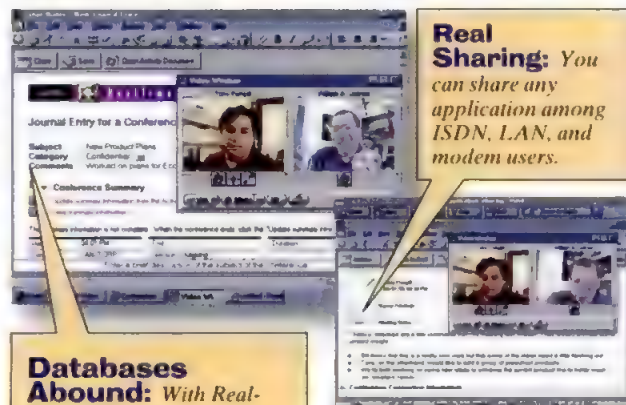
Live from Lotus, it's RealTime Notes Release 2. A marriage of Intel's ProShare conferencing software and Lotus Notes, RealTime Notes lets you and other users simultaneously create and edit any Microsoft Windows-based document. And if you want to

Intel technologies in RealTime Notes produces a toolbox of real-time collaboration utilities that enhance Notes' existing groupware functionality. The combination of Notes databases and APIs, and a streamlined version of the ProShare conferencing software—called ProShare

The ProShare Premier software includes several applications for creating and editing documents as well as built-in utilities, such as the Application Sharing software, which lets you turn any off-the-shelf application into one that's shared. The ProShare Premier portion of RealTime Notes works over ISDN or a modem. It also runs over a LAN and is compatible with IPX/SPX, NetBIOS, and TCP/IP.

The core RealTime Notes package comes without videoconferencing. If you plan to implement videoconferencing, you need a LAN or ISDN connection and a budget with a few more zeros. The video is only supported if you also have Intel's ProShare Conferencing System 200, which is a hardware and software package that includes a digital camera and sound board and costs \$1,995. ISDN users, however, can sometimes get the system for \$999 from ISDN service providers.

Though the videoconferencing portion is optional, RealTime Notes still has all of ProShare Premier's meaty conferencing applications. You get the Address Book Application Sharing, File Transfer, Notebook, and PhotoExchange. RealTime Notes essentially builds hooks into the Notes



Databases Abound: With RealTime 2.0, you can track ProShare conferences in Lotus Notes databases.

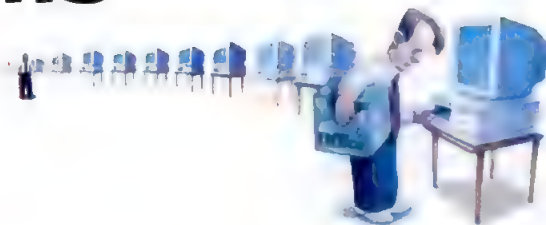
work in larger teams, this newest version of RealTime Notes also supports ProShare's multiuser conferencing and optional videoconferencing. Implementing all aspects of RealTime Notes—which means investing in Intel's ProShare Conferencing System 200—can, however, run into a significant amount of change.

The union of Lotus and

Premier—lets users initiate conference sessions to share data and collaborate on documents without leaving Notes.

To be fair, the star here is Intel's ProShare Premier. A cornucopia of conference management software, ProShare Premier enables users to share standard Windows applications, collaborate on documents, engage in conference calls, or go all out with optional full-motion videoconferencing.

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NETWORK EDITION

First Looks

Windows client, which makes it easier to launch these applications from Notes SmartIcons and manage ProShare conferences.

At the Notes application level, Lotus has added a series of features that make it simple to manage these conferences from within Notes. A new Notes mail form—RealTime Notes Message—automatically appends ProShare addressing information to messages, which allows Notes users to send voice or video conferencing information attached by default.

RealTime Notes also includes a new Journal, which lets you manually summarize conference sessions, and a Conference Activity Log. RealTime Notes also gives you Notes public and personal Address Books to store such conference call in-

formation as ISDN and modem phone numbers, LAN addresses, and even ProShare Business Cards containing attendee information. These are Notes databases, so they can be stored locally on servers and distributed through Notes replication.

We tested RealTime Notes with the full ProShare Video Conferencing System 200. The ProShare installation—including the video and audio/ISDN boards—was fairly simple. You need an ISDN modem and NT-1 interface, however, because the Audio/ISDN board provides only a physical connection to the NT-1. And if you plan on using a LAN, you also need to configure all your Notes users, so you must install the \$499 LANdesk Personal Conferencing Manager. This is software that runs on a dedicat-

ed, networked Windows 3.x PC and lets you limit how much network bandwidth ProShare conference users consume.

On the Notes side, a simple installation walks you through creating the Notes Log, Journal, and Preference databases, as well as the installation of the ProShare Premier software. One installation quirk: RealTime Notes includes development APIs based on Windows DLLs to let Notes developers access RealTime Notes and ProShare, so you must install the 16-bit version of Notes, even on Windows 95 PCs, because ProShare is 16-bit. This can affect Notes performance and is a nuisance when installing RealTime on existing Notes clients.

If you want to take advantage of RealTime's multipoint

option for conferencing up to six users simultaneously, you need to subscribe to ISDN-based multipoint services or invest in your own multipoint control unit (MCU) for your LAN. LAN multipoint is limited to application sharing; there is no video- or audio-sharing.

The addition of ProShare Premier is a nice complement to Notes' groupware-based product strategy. Though expensive to implement with video, RealTime Notes is an application-sharing technology that allows basic but useful real-time document collaboration and voice conferencing.

RealTime Notes Release 2.0. List price: Per user, \$59.95. IBM/Lotus Development Corp., Cambridge, MA. 617-577-8500; www.lotus.com. Circle 954 on reader service card.

WIRELESS BRIDGES

AirEZY Is Hot off the Wire

By Padraic Boyle

Bridging the gap between two geographically separated networks is becoming easier—and cheaper—thanks to OTC Telecom's wireless AirEZY Bridge. The \$3,500 AirEZY provides an inexpensive way to connect two networks that are up to 2-miles apart at a data rate of 1 megabyte per second (MBps). Though this may not seem like breakneck speed, the AirEZY does transmit data at approximately the same rate as a dedicated T-1 line, which will cost you between \$1,000 and \$1400 a month in line charges, not to mention the cost of the router equipment you need. The AirEZY also eliminates the complex hardware and the need to deal with telephone carriers inherent in a T-1 installation.

To work properly, however, the AirEZY requires a line of site between the unit's two antennas. This means no trees, buildings, or other impermeable obstacles can be between the two sites. Depending on

the physical layout of your buildings, this may not be possible. Additional equipment is available that will extend the height of the antennas, or OTC will customize a workable scenario with multiple bridges to direct the signal around obsta-

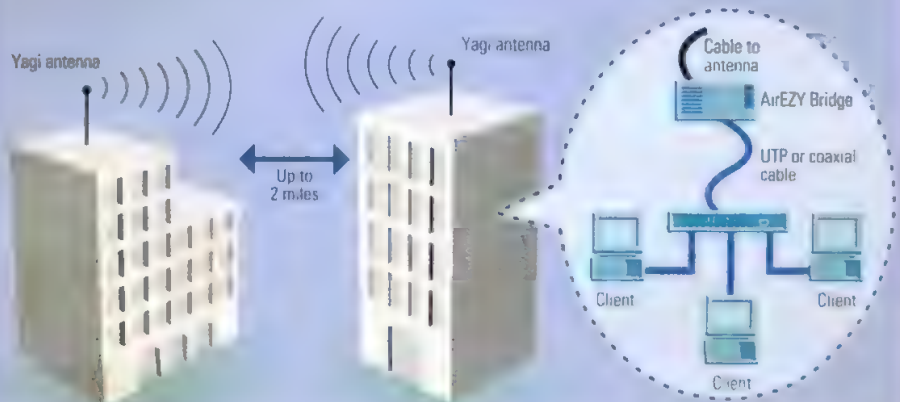
cles. But the additional equipment means additional costs.

AirEZY operates only between two networks. Other bridges—Proxim's RangeLink Series 1500 (\$6,000 per pair), for example—connect multiple networks up to 25 miles apart and aren't as hindered by physical obstructions. OTC offers a multiple-LAN bridge for an additional fee.

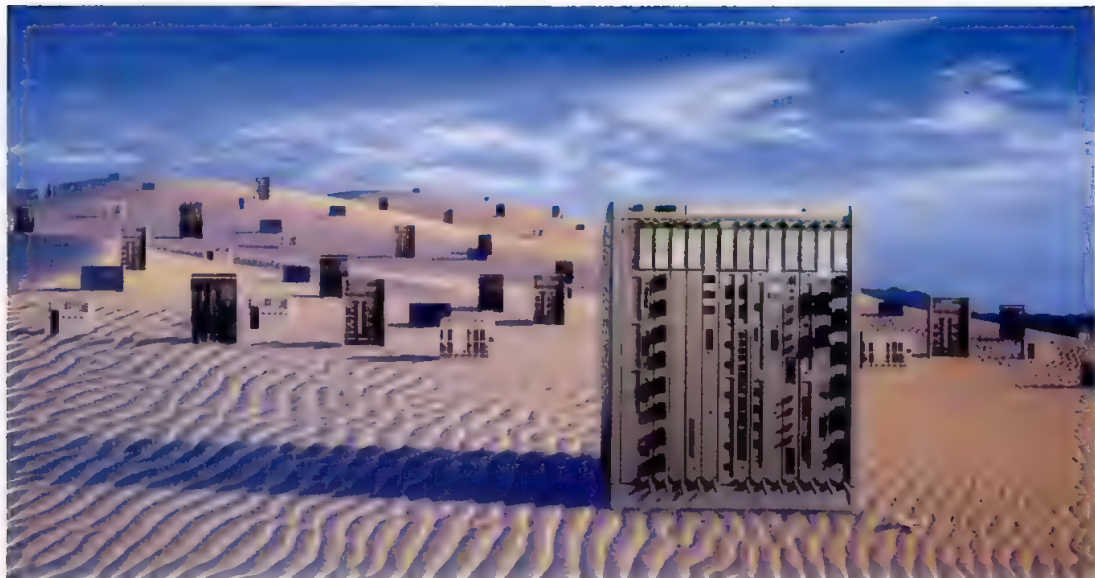
Based on the IEEE 802.11 standard, AirEZY uses direct sequencing spread-spectrum (DSSS) radio frequency (RF) technology, which operates in the 902- to 928-MHz range. The AirEZY is protocol-independent and works with any Ethernet LAN. In addition, the AirEZY supports all popular NOSs, including Microsoft Windows NT, NetWare 3.x and

Suspending the Bridge

Once you get all those trees and tall buildings out of the way, setting up the AirEZY Bridge is straightforward. You attach the bridge unit to each LAN with a UTP or coaxial cable, mount the Yagi antennas, point them toward each other, and wait for the LEDs to light up, indicating that the connection is made.



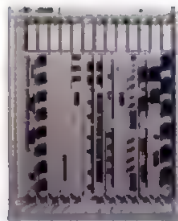
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First Looks

4.x, VINES, and Macintosh, without any modifications to the network or clients.

As the name implies, AirEZY is simple to install. It comes with two bridging radio units and two outdoor directional Yagi antennas for point-to-point connectivity. Each 1-by-3-by-6-inch radio unit houses both the wireless electronics and the UTP and BNC Ethernet connections. Also included are mounting brackets for the antennas and two 40-foot cables. The mounting brackets let you install the antennas on a building top, and the cables connect the antennas to the bridging units on the wired portion of the LAN.

To make the wireless connection, you simply attach the bridge unit to each LAN, mount the antennas on the rooftop, and point them towards each other. Antenna positioning is accomplished by using a set of LEDs on each bridging device; you don't need any additional software or drivers. If the antennas are pointed directly at each other, the lights indicate that a link has been established. Getting a link may be more difficult than you expect.

In situations or settings where the LANs are close together, such as a campus or business park, the AirEZY ex-

cels. Though the AirEZY claims to support networks that are as much as 2 miles apart, it is probably better suited for those that are closer together.

Security is the primary reason that OTC chooses to offer setups for only two networks. Unauthorized access to the bridging units is difficult, however, as the units communicate only with each other. In combination with the design of spread spectrum technology that is inherent in the AirEZY, this makes it almost impossible to tap into the network.

In addition to the AirEZY Bridge, OTC offers the AirEZY 900 (\$600 list) for

desktops and laptops. The AirEZY 900 connects to any standard 10-Mbps Ethernet adapter, and it converts the signal for wireless communications. Another OTC product, the AirEZY 900 wireless LAN solution, works with existing NIC drivers, but it requires an additional NIC (approximately \$100). OTC also plans to release DSSS wireless bridge and client devices that will operate in the 2.4- to 2.438-GHz range.

AirEZY Bridge. List price: \$3,500. OTC Telecom, San Jose, CA; 408-245-6888; fax, 408-245-8886. Circle 953 on reader service card.

ISDN ADAPTERS

The Diva Soars with Portable ISDN

By Les Freed

If you're ready to take your ISDN to go, then Eicon Technologies has served up just what you need with its \$545 Diva T/A. The Diva T/A is an ISDN terminal adapter with an NT-1 interface on a Type-II PC Card. The Diva provides true portable ISDN by allowing you to configure it for two locations, which are detected automatically. In addition, the Diva can operate with virtually any ISDN-capable central office worldwide, including AT&T 5ESS and National ISDN-1 for use in North America; EuroISDN; and JATE in Japan. Also, the NT-1 interface is approved by the FCC and Industry Canada.

Though portable ISDN may not yet make sense to everyone, there are several applications for portable ISDN cards. The most obvious application is for laptop users who have ISDN both at home and at the office. And because the Diva looks and works like an ordinary analog PC Card modem, it can also be used as an ISDN upgrade for routers and modem pools that use PC Card modems.

The Diva does, however,

have some shortcomings. The current version doesn't support Multilink PPP (MP), so data connections are limited to one 64-Kbps connection. In addition, the Diva's configuration process is challenging, re-

tributes that help compensate for these deficiencies. One is a clever feature that makes moving the card between two locations—such as your home and office—virtually painless. If you've ever set up an ISDN



ISDN GODDESS: The Diva T/A makes remote ISDN possible by storing two sets of configuration parameters.

quiring rudimentary knowledge of AT commands. Eicon is working on a firmware upgrade to add MP and the missing VT-100 configuration menu. Users will be able to download the firmware from Eicon's Web page and install it themselves.

But the Diva has many at-

tributes that help compensate for these deficiencies. One is a clever feature that makes moving the card between two locations—such as your home and office—virtually painless. If you've ever set up an ISDN terminal adapter (TA), you know that you must carefully configure it to match your local phone company's requirements. Specifically, the TA must know what type of central office switch it's talking to as well as the phone number and Service Provider ID (SPID) of the phone line.

Once a TA is configured to work on a specific phone line, however, you can't just unplug the thing and expect it to work on any other line. Until now, that is.

The Diva stores two complete sets of configuration information—one main and one alternate—and automatically switches between the two. To test this feature, we carried the Diva from Florida to our ZD Labs in Foster City, California. The Diva was configured for use on a home line in Florida, and the alternate setting was configured for the line at our Labs. The Diva worked flawlessly at both ends and automatically selected the correct configuration in both locations.

The Diva's installation is easy. It installs in a single PC Card slot and attaches to the ISDN line via an external NT-1 interface box. (The cable between the Diva card and the NT-1 is extremely short—just a few inches—but Eicon includes an 8-foot cord for the ISDN line.)

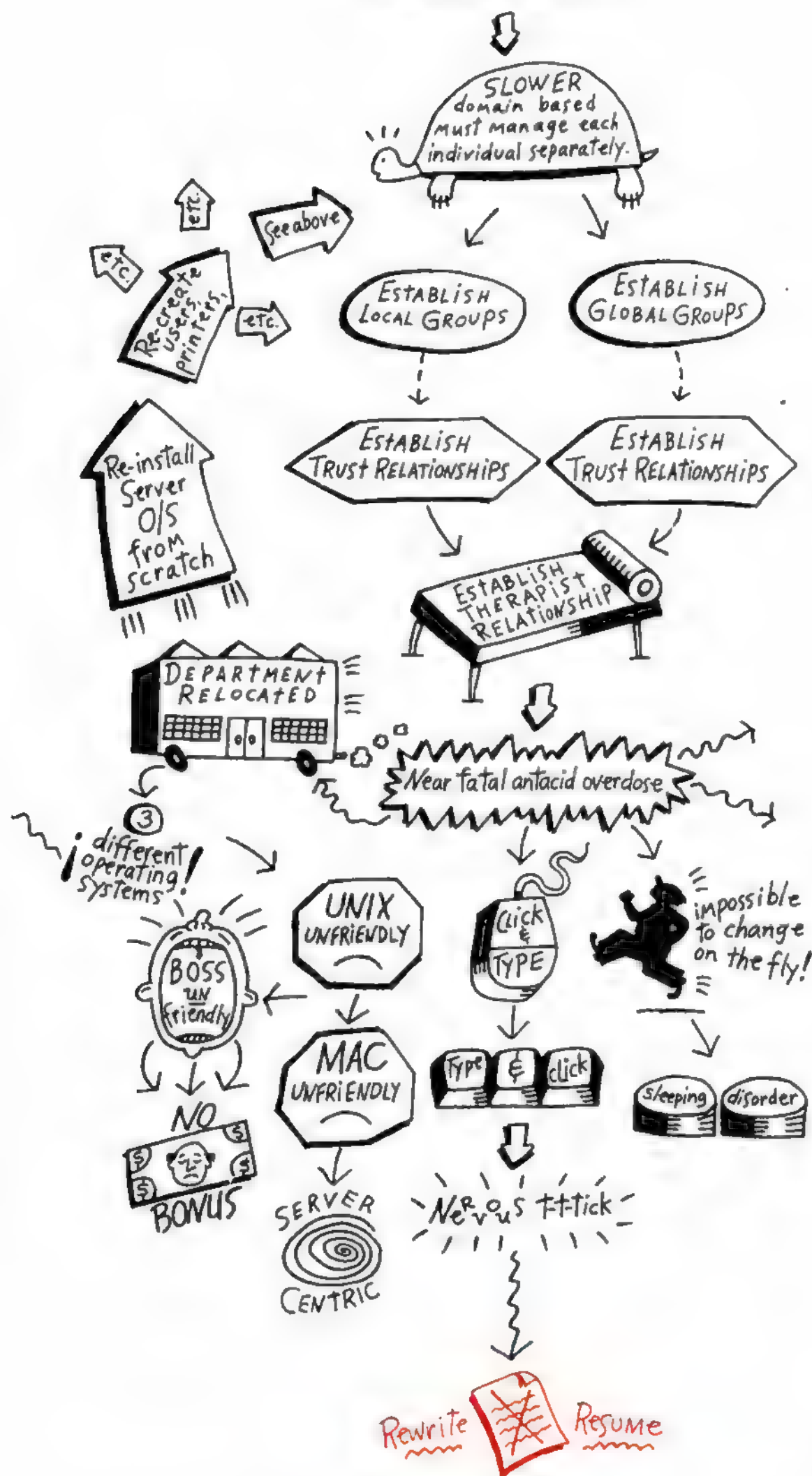
The NT-1 box is several times the size of the Diva and attaches to it using a connector with a sliding tab that locks the cable in place. The connector looks beefy enough to stand up to repeated usage without wearing out. The NT-1 box

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also has two green LEDs to indicate B- and D- channel activity. We found this to be a welcome diagnostic touch that we've not seen on other portable ISDN TAs.

Installation may be easy, but configuration is tricky. The Diva operates like a standard analog modem: It uses a standard COM port address and IRQ line and responds to AT commands from your communications software. Most communications software can talk to the Diva with no special drivers, and Eicon includes an .INF file for Microsoft Windows 95 users. The first time we plugged the Diva into a Toshiba notebook running Windows 95, the Windows 95 Plug and Play manager recognized the Diva and asked us to install the Diva floppy disk.

The Diva manual claims that the Diva has a built-in configuration menu, accessible by any VT-100 emulation program, a method similar to that used by Adtran and Motorola to configure their desktop ISDN products. But when we started Crosstalk and entered the command to bring up the menu, the Diva responded with the terse message, "VT100 menu not implemented yet." Before you can use the Diva, you'll have to fire up a terminal program and learn a few AT commands, because that's the only way to enter the configuration information.

Once the Diva was successfully configured, we were able to connect to a variety of ISDN routers and terminal adapters, including equipment from Ascend, Motorola, and Shiva with no problems. We also used the Diva to connect to several ISDN-equipped Internet service providers without a hitch.

Diva T/A. List price: With S/T interface, \$495; with U interface, \$545. Eicon Technology Corp., Montreal, Quebec, Canada. 514-745-5500; www.eicon.com. Circle 951 on reader service card.

NETWORK TESTING PROGRAMS

DynaMeasure Tests the Rev of Your Network

By Alex Ho

When top-notch car companies need to check engine performance, they build an in-house racetrack. Bluecurve has built its own version of the in-house track, called DynaMeasure, for your client/server network. This product lets you take your network on its own kind of road test. The \$29,995 network-testing program uses ODBC database transactions to test your client/server network, putting it through a course only experts could devise.

DynaMeasure applies controlled workloads to your client/server network. It instructs several PC clients to perform database transactions using a Microsoft SQL Server, which is purchased separately.

The program measures how long the SQL Server takes to complete transactions between the clients and the server and measures the number of transactions completed per second. Then it reports the measurements for response time (in seconds) and throughput (in transactions per second).

With DynaMeasure, you can find performance bottlenecks, make component upgrade decisions, and determine the reliability of your network.

To install DynaMeasure, your server must run Windows NT and SQL Server 6.x; your clients should run Windows 95 or Windows NT. DynaMeasure creates a test and a control database in your SQL server. You must install the DynaMeasure Manager in each of your clients. The Manager has three software components: a builder, a dispatcher, and an analyzer. DynaMeasure also needs a dedicated client that uses the DynaMeasure Operator to coordinate communication for all computers and the DynaMeasure Motors to execute network database transactions.

To put DynaMeasure through its paces, we set up a simple client/server test-bed that consisted of a Windows NT 3.51 server and workstation. We installed Microsoft SQL data-

base Server 6.5 on our server and then connected two computers using a Cabletron 10Base-T hub, two 3Com 3C509 10-Mbps network adapters, and Category 5 UTP cables. We collected a set of test results for this test-bed.

We swapped our 10Base-T hub and 10-Mbps adapters for an Intel 100Base-T hub and Intel 100-Mbps adapters, and reran the same DynaMeasure tests. We found no difference in performance. In the next round, we increased the memory size in the Windows NT server from 32MB to 64MB and went for another lap. This time we observed an improvement in performance.

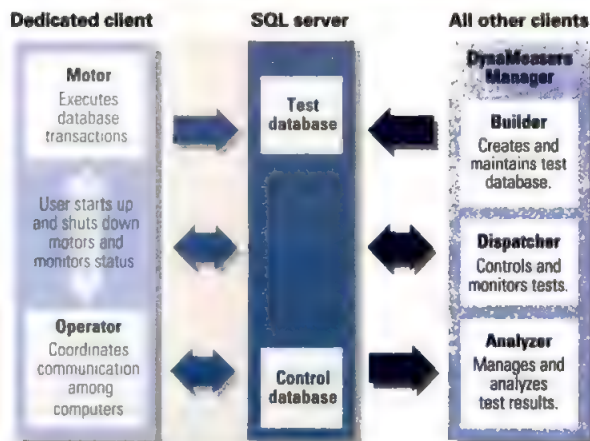
Through these tests, DynaMeasure helped us discover that we could increase network performance by adding more memory to our server. We also learned that we shouldn't waste money on upgrading our network connection from 10Base-T to 100Base-T.

Though DynaMeasure is a close-to-perfect racetrack to test your client/server network on, we did hit a few bumps. DynaMeasure supports only Microsoft SQL Server, though other database support is planned. And though DynaMeasure helps troubleshoot the bottlenecks in your network, it won't resolve them; you still need client/server expertise to fix the problems. And when testing a production network, be careful about the amount of stress you place on the system, so DynaMeasure doesn't halt your servers or crash your applications.

DynaMeasure. List price: For 1 server and 50 motors, \$29,995; each additional server, \$2,495; each additional 25 motors, \$2,495. Bluecurve Inc., Oakland, CA; 510-267-1500; fax, 510-267-1501. Circle 952 on reader service card.

Measuring the Dynamic Flow

To run its tests properly, DynaMeasure relies on its many components and the information that flows among them. To acquire the necessary data requires lots of behind-the-scenes maneuvering.



All clients run under Windows 95 or NT.

NFS

for Windows NT 4.0

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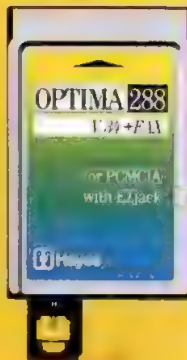
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** Available on OPTIMA 288 Standard Modem and Century only
*** Available on OPTIMA 288 Business Modem only

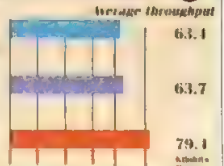
Independent industry testing continues to prove that Hayes OPTIMA modems are the fastest you can get*. It's no wonder Hayes OPTIMA has captured so many industry awards for technology, performance and preference. It's Windows NT compatible, too!

In addition to the performance features of OPTIMA, the Hayes Century 2 now offers an SNMP management agent that works with all SNMP-compliant network management software. Hot swapping insures minimal downtime. Backed up by Hayes' legendary support and service, Century 2 is the right choice when speed and reliability are crucial.

For more information on Hayes Business Solutions, call Hayes Fax Response at 800-HAYES-FX and select Document 976. Or call 800-374-8388, Ext. 720.

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NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Michelle Schoenung

Dazel Delivers to the Web

DAZEL CORP. WILL SOON add a new destination to its Output Server product for managing output in

report to employees across the country via MetaWeb. The Dazel Output Server receives the information and performs necessary document transformation. MetaWeb notifies the employees that the document is available and can be accessed through its link on the corporate intranet.

According to the company, a Unix version of Output Server with MetaWeb capabilities will be available in early 1997.

Dazel Corp., Austin, TX, 800-357-8357; www.dazel.com. Circle 958 on reader service card.



METAWEB extends Output Server's functions.

client/server applications.

The MetaWeb will incorporate Internet and intranet technology to extend Output Server's reach beyond current hard copy and electronic destinations.

For example, an accounting department can publish a sales

Security Solutions

TWO NEW PRODUCTS from McAfee promise to enhance network security.

Secure-1 (\$100 per node for 1,000 users) is a suite consisting of three software programs, including antivirus and encryption features.

McAfee has partnered with Seagate Software to offer the **NT-sential** (pricing not yet available), an antivirus and server backup solution.

McAfee, Santa Clara, CA; 408-988-3832; www.mcafee.com. Circle 960 on reader service card.

Shared Scanning

FOR THOSE WHO DON'T have the budget to saturate the office with scanners, Kofax Image Products introduces the **Netscan** workgroup scan server (\$895 for server and software).

This software/hardware product connects a Hewlett-Packard ScanJet scanner to a NetWare network via the SCSI port over 10Base-T Ethernet.

Users can share the scanner and are able to route scanned images across the network using e-mail.

Fax capabilities, native Microsoft Windows NT support, and more protocol options are expected in later versions.

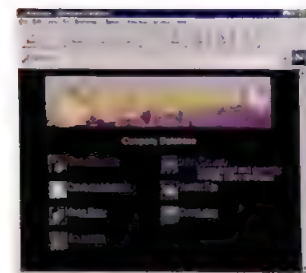


WORKGROUP SCANS: Users e-mail scanned images to themselves.

Kofax Image Products, Irvine, CA; 714-727-1733; www.kofax.com. Circle 957 on reader service card.

CD Access via The Intranet

MERIDIAN DATA'S CD INTRANET (\$16,000 with 14 CD-ROM drives) lets network administrators manage and deliver CD-ROMs on the intranet.



CD INTRANET works over any TCP/IP-based LAN.

Users can simultaneously access CD-ROM databases and libraries by clicking on hypertext links in intranet pages.

The CD Intranet includes a server with up to 56 CD-ROM drives, CD Net networking software, and CD Web launching application software.

Meridian Data, Scotts Valley, CA; 800-767-2537; www.meridian-data.com. Circle 959 on reader service card.

HOT PROSPECT

One-Touch Assistance

Networking companies typically don't design products with the support staff or help desk in mind. That's why Fluke's **OneTouch Network Assistant** (\$3,695 for 10-Mbps Ethernet configuration; \$4,995 for combination 10/100-Mbps Ethernet model) seems like, well, such a fluke. That is not to say that this handy little device isn't chock-full of great features.

With an icon-based interface and touch-sensitive screen, the hand-held OneTouch Network Assistant is useful for troubleshooting and installing 10- and 100-Mbps Ethernet network connections.

The product provides such Ethernet performance information as collision and utilization rates, errors, and broadcasts. A Network Advice feature can be activated at the touch of an LED soft key to interpret information for the user.

An auto-test feature—which relies on cable and packet-level tests—gauges network connectivity from desktop stations to local routers and Microsoft Windows NT, NetBIOS, and Novell servers. If a problem is detected, a flashing icon appears that can be clicked on for more information. The auto-test feature performs individual tests for NICs and hubs.



Fluke Corp., Everett, WA; 800-443-5858; www.fluke.com. Circle 955 on reader service card.

NETWORK EDITION

New & Improved

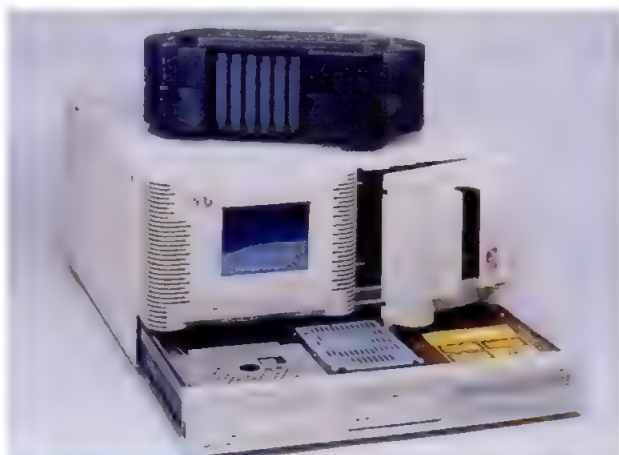
Options for Storage

MEDIALOGIC ADL HAS announced its second generation of SLA (scalable library architecture) automated storage libraries.

The **4-mm SLA-4** (\$7,500) holds up to 65 tape cartridges, and the **8-mm SLA-8** (\$7,500) can handle up to 52 tape cartridges.

Both products are hot-swappable and have a Mixed-Media interchange drawer. The drawer can be configured with as many as three removable SCSI drives and two 3.5-inch fixed disk drives.

Other features included are multiple-host access and data



SLA STORAGE LIBRARIES come with a MixedMedia interchange drawer that can be configured to your specifications.

ID. SLA libraries respond to requests from both Microsoft Windows NT and Mac systems.

MediaLogic ADL, Boulder, CO; 303-939-9780; www.adl.com. Circle 963 on reader service card.

Guardian's Firewall Monitoring

THE FIREWALL IS, IN SOME respects, the most important aspect of your network. So vendors are beefing up firewall management capabilities.

The latest incarnation of NetGuard's icon-based Guardian firewall software for Windows NT and OS/2 incorporates real-time user monitoring and bandwidth control.



FORGOTTEN FIREWALL no more: now with management functions.

Guardian, Version 2.0 (\$3,980 for a 50-user version; \$6,980 for an unlimited-user version) enables network administrators to view the activities of each Internet-connected host and generate customized reports to analyze Internet usage.

NetGuard, Carrollton, TX; 800-533-8439; www.lanoptics.com. Circle 962 on reader service card.

UB Networks Lets You Manage Your Network from the Web

IT SEEMS YOU CAN DO almost anything from the Web—including monitoring and managing your network.

UB Networks' **NetDirector@Web**—a suite that allows enterprise management from a Web browser—comes with applications that provide real-time network analysis and advice.

EMPower Critical Node Monitor, EMPower Java Real-time Management Applets, and the Automated Network Monitoring System are a few of the applications in the NetDirector@Web family. The NetDirector Homepage application provides an integrated directory for the network by hyperlinking all of the EMPower

Java management applets.

The Netdirector@Web software is complemented by hardware modules, which can be embedded in network devices. This enables administrators to acquire real-time data. Product pricing is not yet available.

UB Networks, Santa Clara, CA; 800-777-4526; www.ub.com. Circle 961 on reader service card.

BRIEFS

Hardware

If you're in the market for a workgroup Fast Ethernet hub, you may want to consider D-Link System's 8-port **ProFast** (\$995). This unmanaged hub features an uplink port for cascading up to 2 hubs and increasing port density to 14 ports. 800-326-1688 Intel Corp. has announced a new technology that promises to enhance the performance of its **PCI EtherExpress PRO/100** (\$129) and **PCI EtherExpress PRO/10+** (\$98) adapters. Intel says its **adaptive technology** now dramatically reduces network col-

lisions. You can download it from Intel's Web site (www.intel.com) 800-538-3373 XCD's new **XConnect 100** print server (\$595) is an external box that can connect to either 100Base-TX or 10Base-T networks. It supports two IEEE 1284 parallel ports and one serial port for connecting printers. 714-573-7055 Plaintree Systems has announced the **WaveSwitch 1019** (\$5,495). The WaveSwitch features 16 10Base-T Ethernet ports, a 100Base-TX and a fiber-optic 100Base-FX port. The SmartVIPS (intelligent virtual IP subnets)

utility helps form and manage VLANs for IP networks. 800-370-2724 Making a foray into the enterprise networking market, Microtest introduces its **CD-NOW! E/Server** turnkey CD-ROM server. This rack-mounted system includes Microtest's CD-NOW! software for up to 100 users (the E/Server is expandable to as many as 1,000 users), a CPU, storage arrays, a 3.5-inch internal floppy disk drive, and an ISA VGA video adapter. Prices start at \$32,900 (for 21 8X cold-swappable drives). 800-526-9675.

New & Improved

Open-System Remote Access

THOSE LOOKING FOR A nonproprietary remote-access server may want to check out RAScom's **RAServerSeries 2000** (prices range from \$8,500 to \$50,500 depending on configuration).

The product family now consists of the RAServer 2000 and the RAServer 2500.

The 2000 is an entry-level server that includes a Pentium PC running Windows NT. It consolidates two primary-rate ISDN spans or eight BRI spans for high-speed access for as many as 60 concurrent remote users.

The 2500 is a rack-mounted ISDN server for remote ac-

cess to the enterprise backbone. It also includes a Pentium PC running Windows NT. It supports up to four



THE STURDY 2500: provides high-speed remote access to the enterprise backbone.

ISDN spans or 32 BRI spans and as many as 120 concurrent remote users on the enterprise backbone. RAScom Inc., Salem, NH; 603-898-5200; www.RAScom.com. Circle 967 on reader service card.

Groupware Integration

NETWORK ADMINISTRATORS may want to leap over the Groupware collaboration gap with The Mesa Group's **JumpStart** (software \$5,000-\$7,500 per server at press time; the price is subject to change) for seamless data conversion.

Using high-fidelity, bidirectional replication between Lotus Notes databases and Microsoft Exchange folders, the program allows Lotus Notes users to communicate and share data with Microsoft Exchange users across a LAN or WAN.

JumpStart converts discussions, custom databases, document attachments, document links, OLE objects, rich-text formatting, and discussion threading.

Its management tool allows administrators to control data mapping and conversion. The software runs on both Microsoft Windows 95 and Windows NT workstations.

Mesa implements JumpStart in a three-phase process, which includes site survey, training, and implementation. **The Mesa Group**, Newton, MA; 800-329-9140; www.mesa.com. Circle 965 on reader service card.

ChatCom's Server Family

CHATCOM MAY HAVE come up with an inexpensive way to organize your wiring closet.

ChatCom's family of SNMP-compliant communication server products come in two scalable and affordable solutions. Both the **ChatterBox Corporate Series 2000** (\$6,200 for base configuration) for large-scale central offices, and the **ChatterBox Office Series 200** (\$1,370 for base configuration)

for departmental needs, come with an enclosed rack mount and a power supply.



Server modules, which are sold separately and start at \$2,260, come with Intel 100- to 200-MHz processors and PCI or ISA expansion slots for physical connections to your LAN or WAN.

Management software runs on both Microsoft Windows 95 and Windows NT computers. **ChatCom Inc.**, Chatsworth, CA; 800-456-1333; www.jlchatcom.com. Circle 964 on reader service card.

SERVER SOLUTIONS: Scalability to suit your company's needs.

BRIEFS

Software

Attachmate Corp.'s **NetWizard Plus 1.0** enterprise management software (\$99) now comes in a remote control-ready version. This allows network administrators already using the software to manage large, distributed networks and provide remote-control capabilities to any NetWizard-managed desktop. The new version also adds centralized management of Microsoft Windows 95 and Windows NT "policies" to NetWizard's core functionality. 800-426-6283 Ascent

Solutions introduces **NetSqueeze** (\$149 for five users) for those who want to increase space on a NetWare file server. NetSqueeze operates transparently to reclaim between 60 and 80 percent of disk space used by data files and about 50 percent of disk space used by .EXE, .COM, and overlay files. 513-847-2374 NetSuite Development's new **NetSuite Professional Audit Version 1.0** integrates network discovery, design, and documentation processes. (A license costs \$1,495; a maintenance and support

plan is available for \$225 a year.) Professional Audit pools topological information from direct SNMP and NetWare discovery to form a consolidated network model. 800-638-7848 World Software Corp.'s **Worldox 96** (\$249 per concurrent user) is an enterprise document manager that now comes in a 32-bit version. The software offers native support for many Windows 95 applications and includes features like an ISYS 4.0 search engine and viewer capabilities with Internet file-format support. 800-962-6360.

Upgrading an overpacked laptop sure can be slow.

If you're running out of portable hard drive space, why waste time with a manual transfer? Speed up with VisionTek's ExtremeDrive™ — the all-in-one solution for boosting storage capacity.

Choose from 1.3GB and 2.1GB upgrades for portables from leading manufacturers like



1. Install Drive Exchange

Toshiba®. All equipped with the patent-pending Drive Exchange™ data transfer system. Unlike other hard drive upgrades, ExtremeDrive requires no reinstallation of the operating system, drivers or applications — saving valuable time. The whole process takes only about an hour.



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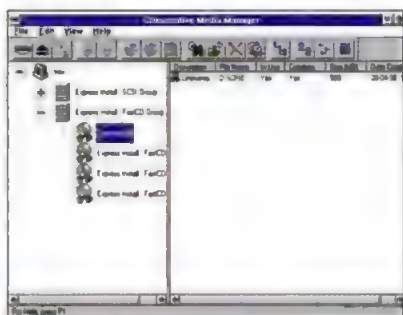
The New CDexecutive 2.0

LOGICRAFT HAS RE-vamped its CDexecutive software for enabling CD-ROM access from Microsoft Windows NT servers.

CDexecutive 2.0 (starting at \$999 for as many as 15 CD-ROMs) now has such features as consolidation of file shares under a single drive letter on Windows NT servers; sharing of CD-ROMs over mixed networks; and jukebox support.

This version of the product also adds

NFS support for Unix networks. **Logicraft Information Systems Inc.**, Nashua, NH; 800-880-5644; www.logicraft.com. Circle 966 on reader service card.



WINDOWS NT CD-ROM ACCESS: Logicraft software promises to make it easy.

Voice/Fax Over IP

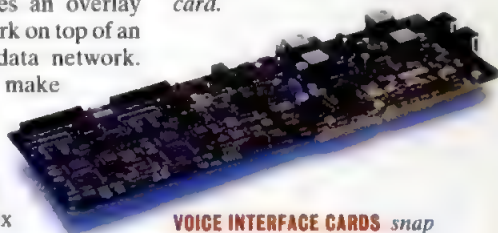
MICOM COMMUNICATIONS Corp. introduces a way for companies to save money on long-distance telephone bills by providing the means to make phone calls over the IP network.

The **V/IP** (Voice Over IP) (starting at \$770 per voice/fax channel) creates an overlay voice/fax network on top of an enterprise IP data network.

Users can make free G.729 toll-quality intracompany calls from any telephone or fax machine.

V/IP's digital voice interface cards (VICs) plug into a single PC (operating NetWare, DOS, Windows 95 or Windows NT) at each enterprise location.

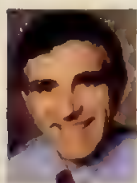
Micom Communications Corp., Simi Valley, CA; 805-583-8600; www.micom.com. Circle 968 on reader service card.



VOICE INTERFACE CARDS snap into a PC at each location.

MULTIPLE ACCESS By Frank J. Derfler, Jr.

Gigabit Ethernet: Should You Care?



Pilots say that an airplane has to look good to fly good. Somehow, pilots sense what's right. Similarly, I love Gigabit Ethernet because it feels right. Its competition, 155-Mbps ATM, has never felt right to me. I spent years trying to optimize data streams flowing over communications circuits. I learned that streaming and low

data overhead always work to keep costs and problems down. Chopping the data into little packets and adding overhead—the ATM approach—horrifies me. Gigabit pipes—let me call it Gig E for short—thrill me.

Okay, ATM will cross oceans and Gig E won't go beyond 500 meters, so there is a difference. But why introduce ATM for your inter-switch/router backbones when initial Gig E products are rolling out now? Gig E is building on existing Fibre Channel technology, although the signaling will speed up to 1,250 Mbps from Fibre Channel's pokey old 850 Mbps.

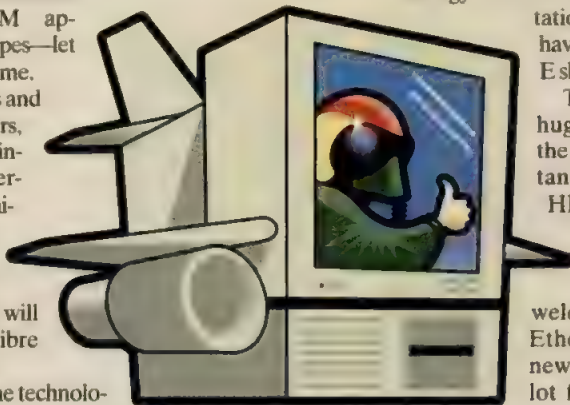
You'll use Gig E as a backbone technology. I don't foresee any Gig E—desktop connections. The high fixed cost of fiber-optic transceivers doesn't allow them to compete with copper, and the copper cable industry has done a superb job of staying up with the over-100-Mbps technology. Gig E backbones over fiber fit in beautifully with 10- and 100-Mbps Ethernet over copper for both server and desktop connections. Gig E will replace existing FDDI

backbones and close your infrastructure to those choppy little ATM cells. ATM is great for the delivery of synchronized images and sound. So if you're in the image-and-sound business, ATM is for you. But if you're in the data-hauling business, Gig E will carry your loads around the campus.

One of my favorite maxims is, "Switch whenever you can, and route only when you must." That's a good way to design big networks. Gig E let's you do both. Ethernet switching is a great technology—it's like infinite and instant network segmentation—and Gig E fits right in. If you have 500 active nodes or more, then Gig E should be in your plans.

The momentum behind Gig E is huge. That the folks at 3Com are in the fore is no surprise, but such important companies as Cisco, Compaq, HP, IBM, and Sun are all in the Gigabit Ethernet Alliance. The Alliance members are holding monthly meetings and rapidly

welding known technologies, such as Ethernet and Fibre Channel, into a new structure. But there really isn't a lot for the Alliance to invent. They have a Web site at www.gigabit-ether.net, but I found its information elementary. The 3Com and Cisco Web sites have much better technical data. My best advice is to hold off on ATM investments and to watch the development of Gig E. The standards will fall in place quickly, and interoperable products from many vendors will appear throughout 1997.



Who defends the Department of Defense?



Centri.™ The failsafe firewalls for Windows NT.

When it comes to the US Navy and its Windows NT™ intranets, that would be us. Global Internet. And we were drafted because we offer the only military-grade firewall that's native to—and hooked directly into—the Windows NT source code.

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Bulletproof Windows.

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The Market Share Leader in Firewalls

IDC, 1996



Extensible Application Support

CHECK POINT's flagship product, *FireWall-1*, supports hundreds of new and existing applications. You can create your own custom applications, and *FireWall-1* will support them too. As the first to support multimedia and database applications such as RealAudio, VDOLive, Netscape CoolTalk, and SQL*Net, *FireWall-1* is quick to meet your present and rapidly evolving networking needs. Intranets. VPN's. Internet Commerce—anything and anywhere you want to take your network.

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It's easy to see why CHECK POINT is the market leader in global network security. And with installations at thousands of customer sites worldwide, *FireWall-1* is the most widely tested and trusted solution on the market.

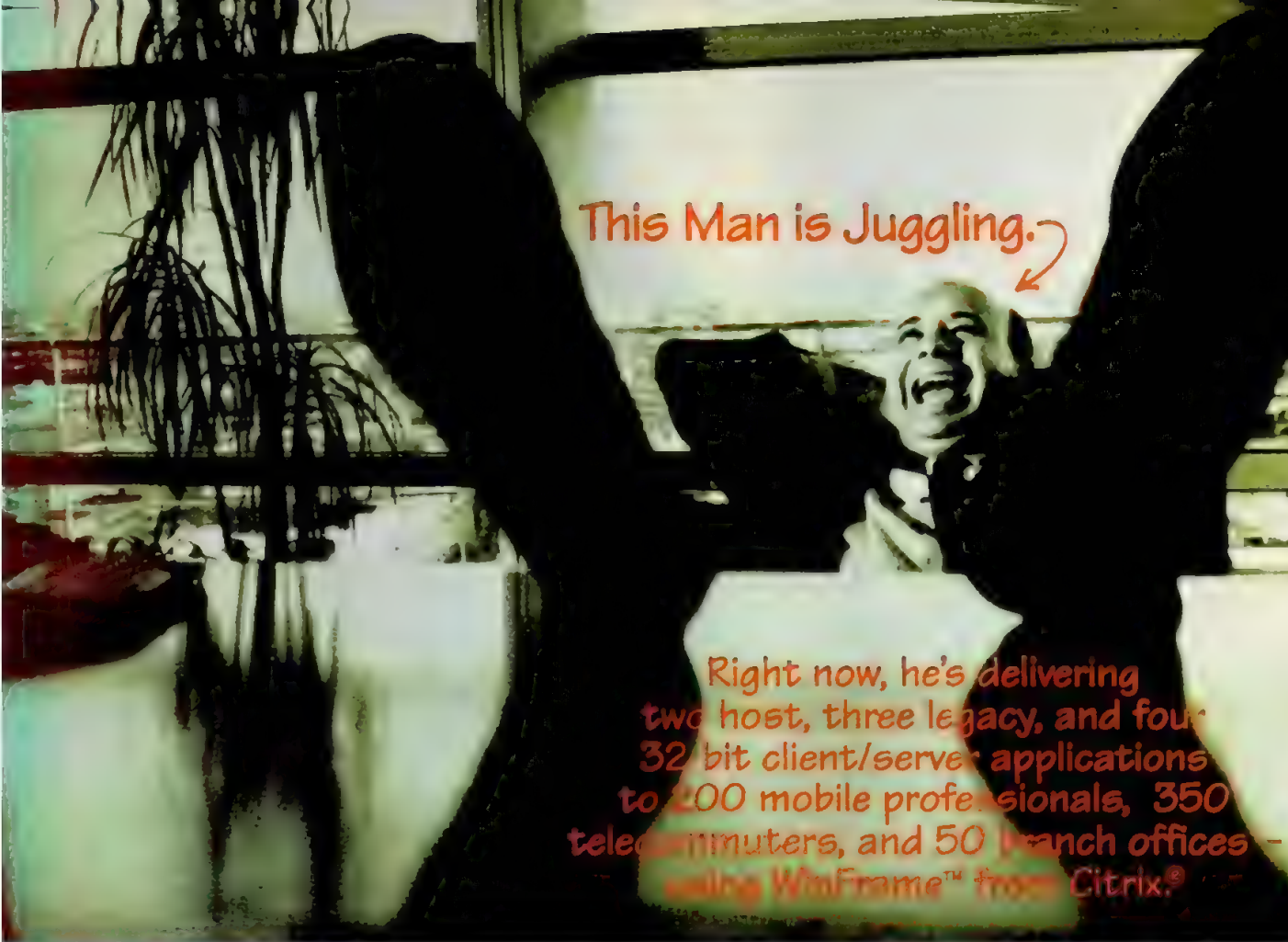
The promise of the Internet is here and with it comes a world of connectivity. CHECK POINT *FireWall-1* lets you enter that world securely.

A FEATURES	STATEFUL INSPECTION	APPLICATION-LAYER GATEWAY	PACKET FILTERS
High Security	●	●	
Performance	●		●
Application-layer Awareness	●	●	
Scalability	●		●
Extensibility	●		

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This Man is Juggling.

Right now, he's delivering
two host, three legacy, and four
32 bit client/server applications
to 200 mobile professionals, 350
telecommuters, and 50 branch offices —
selling WinFrame™ from Citrix®.

It seems like an impossible juggling act — deploying applications outside your LAN to mobile professionals, telecommuters and branch offices. You face high costs. Network bottlenecks. Complicated user configuration. And, worst of all, poor application performance. Even the best remote node servers and branch office routers can't solve these remote computing problems.

WinFrame lets you juggle these challenges with ease. An authorized extension to Windows® NT™ Server, WinFrame turns an ordinary Pentium server into a powerful multi-user application server. Using Citrix's innovative ICA® protocol, WinFrame executes 16- and 32-bit applications on the server, while only the user interface displays on remote desktops. This means WinFrame helps you:

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- **Leverage Your I/T Investment.** WinFrame works with your existing remote access infrastructure, reduces network traffic, and extends the life of your existing desktop hardware. In fact, WinFrame clients can range from legacy PCs to Pentiums, from Macs to UNIX workstations.



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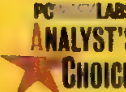
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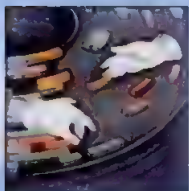
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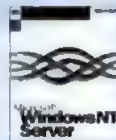
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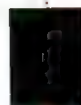
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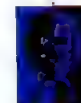
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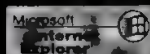
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It's high noon, and ink jets are staring lasers dead in the eye. Laser printers killed off daisy wheels years ago, and ink jets have all but banished impact dot matrix printers to specialized vertical-market applications. Until recently, these two remaining technologies coexisted peacefully, each with its own strengths and its own spheres of influence.

In the past, if you wanted crisp, clean output for professional business documents, you had to use a laser printer. Text from ink jets showed bleeding and fuzziness, unless you

used coated ink jet paper—which, at 10 cents a sheet, was simply not an option for businesses' print volumes. So ink jets were relegated to the home and student markets, where their good-enough print quality was—well, good enough. The added bonus of ink jets' color capability made for nice school projects, but the quality was not suitable for the workplace.

Ink jet hardware has been evolving, though, and the pace of change has picked up over the past year. New ink formulations deliver black-and-white (also called *monochrome*) output

By Alfred Poor



1 INK JET HARDWARE Today's personal ink jets range from \$200 budget printers aimed at students and home users to \$500 printers ideal for moderate-volume business use. Most buyers should settle on a less-expensive three-color unit and opt for a four-color printer instead.

2 INK JET OUTPUT A mid-range four-color unit (about \$350) can produce text that rivals that from laser printers, while color output on good ink jet paper can approach photographic quality.

3 LASER MACHINES While there are still a few 4-ppm units on the market, most makers have upped the ante with 600-dpi engines rated at 8 or even 8+ pages per minute. And the cheapest laser can be had for \$300 on the street.

4 LASER OUTPUT Close as they come, ink jet printers still cannot produce the sharp text and clean lines of a true laser printer, especially on inexpensive copier paper. The typical personal laser is also faster than a competing ink jet, so a laser is still the better choice if you need a primary output device to produce professional-quality business documents day in and day out.

that can pass for laser quality at arm's length. Most users will be satisfied with the text quality for business documents, and only desktop publishers are likely to notice the difference between the output of the better ink jet printers and the low-end lasers. Moreover, the color output from even midprice ink jets (around \$350 street price) is excellent on plain paper and stunning on higher-grade stock. All this makes ink jets more appealing to business and SOHO users, not just the traditional home market: They can now have the versatility of both a good text printer and a personal color printer for reports, presentations, and the like, at an affordable price.

REVIEW CRITERIA

We tested printers new to the market since our printer roundup a year ago. For the ink jet section, we gathered units intended for personal use, as opposed to those for graphic artists or workgroups (which we reviewed in the previous issue). For the laser section, we asked for printers with engine speeds of 10 pages per minute (ppm) or below. We opted not to review dot matrix printers this year, because of the technology's declining market share.

We tested 13 ink jet (or ink jet-class) printers from 5 vendors: Alps Electric, Canon Computer Systems, Epson America, Hewlett-Packard Co., and Lexmark International. The 17 laser printers we tested are from 9 vendors: Brother International Corp., Canon, HP, Lexmark, NEC Technologies, Okidata, Panasonic Computer Peripheral Co., Texas Instruments, and Xerox Corp. Note that this summer, TI announced that it was selling its printer business to Genicom. Genicom plans to phase out personal lasers but will continue to market the microLaser Win/4 (reviewed here) under the TI logo until supplies run out (probably some time in 1997).

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People also used to knock ink jets for

SANS OUTPUT TRAY
Sometimes trimming has gone too far. The Canon LBP-465 has no output tray to catch printouts.

THE LIGHTER SIDE You can make certificates, T-shirt transfers, and even customized lunch bags with today's ink jets.

Editors' Choice

- Business ink jet: HP DeskJet 870Cse, Epson Stylus Color 500
- Business laser: HP LaserJet 6P, NEC SuperScript 860
- Home-office laser: Brother HL-730, HP LaserJet 5LXtra



Those in the market for a personal printer have good choices at every price level. An ink jet is the better choice for light to moderate printing, since you get color as a bonus; heavy-duty business printing still demands a laser.

Business users looking for a fast, reliable ink jet to produce color documents should consider our Editors' Choice winner in this class, the HP DeskJet 870Cse (\$500 street). It produces excellent output in color and black text at a reasonable per-page cost (3 cents monochrome, 8 cents color), and it's fast, rated at 8 ppm for text and 4 ppm for color work. HP has added its new From Start to Business software, so you can easily create professional-looking invoices, letterheads, brochures, and more with the predesigned templates. An honorable mention goes to the Epson Stylus Pro (\$380 street), whose 720-dpi output quality on plain paper is unsurpassed.

For buyers on tighter budgets, our Editors' Choice among mid-priced printers is the Epson Stylus Color 500 (\$280 street). Output samples we produced were knockouts, especially on Epson's 720-dpi paper.

Three midpriced ink jet printers deserve honorable mention. The Canon BJC-4200 (\$280 street) showed good 720-by-360 output, but its real strength is the Canon Creative 2.0 software, which includes templates for creating customized documents for business and a range of family-oriented projects. If your ink jet will serve primarily with the family PC, then consider either the HP DeskJet 682C (\$300 street) or the HP DeskJet 693C (\$350 street). Both printers provide Disney print-project software and the ability to print banners on fanfold paper. The 693C adds photo-ink capabilities for printing near-photo-quality prints.

the high prices of consumables. Special inks and special paper add a lot to the price of a printed page, but the current crop are much more competitive, especially since you can get fine results on penny-a-sheet laser or ink jet paper. Ink costs have also become more reasonable: Many printers can produce a page of black text with about 2 cents' worth of ink, a price that is competitive with that of the personal lasers in this feature.

Another ink factor is the number of colors a printer uses. Earlier affordable color ink jet printers forced users to choose between black-only output and color output consisting of only cyan, magenta, and yellow inks. These *three-color*, or *CMY*, printers could create black by combining those three colors, but the result was often a muddy brown instead of

the crisp black produced by a dedicated black ink cartridge. More and more printers now give you full-time *four-color* or *CMYK* (the *K* stands for *black*) output, with a black ink tank in addition to the three primary colors. This results in much higher quality for both black and color.

A new four-color printing technology debuts in the Alps MD-2010. Meant to compete with color ink jets used primarily for graphics applications, this \$450 unit heats the printhead (rather than the ink, as in a traditional ink jet), which applies dry inks from the ribbon-holding cartridges to the paper. Because the head makes successive sweeps across the page for each color, the MD-2010 is slow. But output is very good, and the cost of a typical color page is a reasonable 3.4 cents.

Ink jet manufacturers have also dis-

LASER PRINTERS

Business users who need a fast primary laser printer should consider either of our 8-ppm Editors' Choices: the HP LaserJet 6P for great print quality or the NEC SuperScript 860 for a great price. The \$800 LaserJet is the reliable workhorse we've come to expect from HP, now equipped with an 8-ppm engine. Its 600-dpi output looks cleaner and sharper than other 600-dpi print we've seen, and its IrDA capabilities let users with similarly equipped portable PCs point and print, with no cables to negotiate. The LaserJet 6P offers networking and paper-handling options that will let it grow with your business. The bargain-priced SuperScript 860 (\$500 street) delivers fine 600-dpi output, and thanks to its 8-ppm engine and new PrintGear print architecture, it was one of the fastest printers in this roundup.

For lower-volume print needs, two lasers merit Editors' Choice status. The Brother HL-730DX (\$400 street) is a bargain-priced 6-ppm printer. Its 600-dpi print quality isn't as good as the HP 5LXtra's, especially on graphics, but the printer is still an excellent choice for home and home-office users. The HP 5LXtra (\$480 street) is a robust 4-ppm unit that delivers the same fine 600-dpi output as its higher-end sibling.

Three GDI printers deserve honorable mention for Windows users. The 6-ppm Brother HL-720 (\$350 street), 4-ppm Okidata OP4w (\$300 street), and 6-ppm Panasonic KX-P6100 (\$390 street) offer solid print quality in compact, affordable packages.

covered the benefits of added-value bundles of software and other goodies. Canon was a pioneer in this movement with its Canon Creative bundle, and now all the major players include similar collections. HP ships Disney family packs and From Start to Business, depending on which model you buy. Lexmark delivers the Lexmark Workshop with its ink jets.

Last year these software packages were primarily rainy-day project kits for kids: T-shirt transfers, cute greeting cards and invitations, refrigerator art for grandma, and so on. But this year the mix is more heavily targeted at SOHO users and small-business shops that need to create small-run, custom-printed business items, such as brochures, letterhead, business cards, and mailers. Not coincidentally, the major ink jet vendors also sell the specialty papers

and inks (including inks for photo output and even neon inks that glow under a black light), which promise to be a source of continuing revenue. We discuss each vendor's offerings in the reviews; we also look at several third-party packages in this issue's After Hours section.

LASERS: NOT DEAD YET

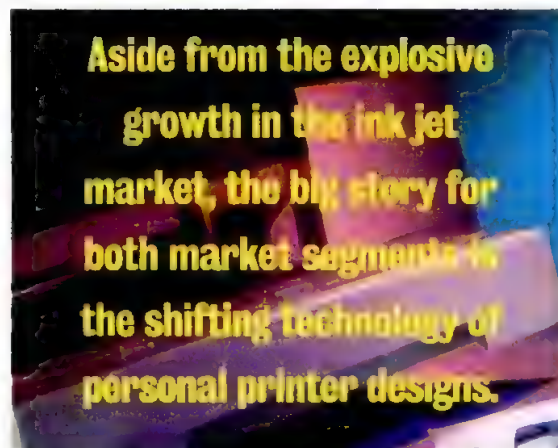
Even though ink jet printers are on the rise, the laser still rules the workplace for the moment. Nearly two out of three business printers are lasers, according to Computer Intelligence. There are many reasons to like lasers. They use proven technology, with an excellent record of reliability; and printing is fast, quiet, and affordable, with near-typeset-quality output in most cases.

Laser makers haven't been standing still, either, continuing the trend toward faster, better output at lower prices. Two years ago, the typical personal laser had a rated engine speed of 4 ppm, delivered 300-dpi resolution, and cost \$800. Last year we saw more 6-ppm and 600-dpi offerings, and this year those specs are the norm and cost as little as \$350 on the street. Moreover, two years ago, 8-ppm engines were the province of shared workgroup devices. Now 8 ppm is affordable enough for the personal market, and 4 of the 17 lasers here deliver it—one for as little as \$500. Every two or three years, manufacturers have cranked up engine speeds by 1 or 2 ppm. By decade's end, a personal laser might run at 12 ppm.

Laser printers are also getting smaller, both to reduce costs and to make them more attractive for cramped spaces. One consequence is often limited paper-handling capabilities as compared with the larger models. Input capacities are often 100 pages or less, and the input paper bin often serves double duty as the manual feed tray, which means removing

the stack of paper for such use. Output trays are similarly restricted—if the printer comes with one at all. A few printers have such contorted paper paths that the manufacturer does not recommend using the machines to print adhesive labels.

Laser manufacturers are taking a cue from the ink jet industry, however, and are making efforts to increase the perceived value of the printer package. A number of the reviewed printers came with accessory software, such as fonts, clip art, and reference materials.



TECHNOLOGY SHIFTS

Aside from the explosive growth in the ink jet market, the big story for both market segments is the shifting technology of personal printer designs. For the most part, the technologies themselves are not news—we've heard about them and seen examples for a few years now—but this time we're seeing broader adoption of these approaches.

First and foremost on the list of technology changes is the move toward host-based printer architectures. In the past, most printers have relied on a printer language to create, or *rasterize*, the image to be printed. For lasers, the field has been divided between Hewlett-Packard's PCL (Printer Control Language) and Adobe's PostScript. Ink jets have generally relied on either PCL or some standard dot matrix printer com-

mand language (such as the Epson or IBM emulation).

The advantage of this approach is that the computer can send relatively compact instructions to the printer's controller, which converts them into the image on the page. Thus the system can rapidly transmit fairly complex pages; with the printer's controller doing the heavy lifting (formatting the image), the computer can go on with other work. The downside is that the printer needs to have a sophisticated computer as its controller, complete with high-powered processor and gobs of memory. And that's expensive.

With the advent of Windows, a new approach became feasible. For a Windows application to put an image of a document or other information on your computer screen, it has to create that image in memory. It does so using the GDI (Graphics Device Interface) that is part of the Windows system. Printer designers realized that the same approach could apply to printing: If you can send a formatted image to the screen, why not send it to the printer instead?

This approach has some significant advantages. The biggest one is the bottom line: A GDI printer costs less to build, because it needs a far less intelligent controller than a PostScript or PCL printer does. The computer performs all the formatting. This also means that you stand a better chance of a WYSIWYG result, because the GDI that puts the image on the screen also formats it for the printer. And because today's computers have become more powerful, their CPUs are likely to have idle processing cycles that can handle the extra work.

There are some downsides to this plan, however. First and foremost, a GDI printer enables you to print only from a Windows or Windows NT application or from a DOS box running under Windows. OS/2 and die-hard DOS users should avoid a GDI printer or look for one that includes a version of PCL to handle jobs. The GDI approach also results in a larger data stream, so it takes longer to transmit the information to the printer. In addition, GDI printing requires system memory, so you may need

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to increase the amount of RAM in your computer if you choose this method. And in spite of the warp speed of today's CPUs, the task of formatting GDI data and sending it out to a printer can noticeably degrade system performance during complex print jobs.

To remedy these shortcomings, a new breed of machines is coming to market; their hybrid architectures split the pro-

cessing tasks between your PC's CPU and a scaled-back processor in the printer. The most notable example in this roundup is the NEC SuperScript 860, one of our Editors' Choices, which employs Adobe's new PrintGear printer description language and a relatively simple controller board to deliver good performance at a competitive price. For a full discussion of host-based printer architec-

tures, see the sidebar "The Second Coming of GDI."

HARDWARE IMPROVEMENTS

The language-based printers have their own responses to the rise of host-based designs. One strategy is to keep costs down by making the most of the hardware inside the case, so designers have turned their attention to memory. A

The Second Coming of GDI

By Laura Cox and Jacqueline Paredes

GDI printers finally may have become what they were cracked up to be. GDI (Graphics Device Interface) or *host-based* printers rely on your computer's processor and memory to convert an image generated with Windows' GDI commands into bitmaps. By employing the computer's processor to generate (or *rasterize*) the image, manufacturers can strip the printer of its sophisticated and expensive controllers, processors, and memory—and drop prices considerably.

Many first-generation GDI printers gave host-based printing a bad name, and rightly so: They were slower than standard printers. And because GDI printing relied on Windows to generate the image, OS/2 and DOS users were told to look elsewhere. But thanks to improvements at the PC, printer, and OS levels, the host-based designs emerging now are worth a look.

First and foremost, today's host-based printers can count on much more powerful PC processors than the 386 CPUs to which their forebears were hooked. A speedy 486 or Pentium has many more unused clock cycles to devote to image rasterization. The operating system, too, has grown more robust: Windows 95's enhanced metafile (EMF) system renders the image and passes data streams to the printer in the background, so you can continue working in the foreground. When you add the higher speed of the new bidirectional EPP and ECP parallel ports, the speed penalty once exacted by host-based printers is minimized

Personal printer vendors have

gotten smarter, too. Brother, Epson, NEC, Panasonic, and others have implemented compression schemes in their printer drivers that compress the rasterized image on the host computer. Once the compressed data stream reaches the printer, a specialized ASIC decompresses it. Each printer vendor has its own spin as to how this process takes place, but the result is the same: faster transmission of the rasterized image and thus improved print speed, at nominal cost.

As for the Windows-only limitation, most printer vendors now provide DOS emulation drivers that allow you to print in a DOS box in Windows. Epson even allows users to print in true DOS or OS/2 mode, by implementing special firmware in its printers that supports the unit's ESC/P2 language.

DO I HAVE THE HORSEPOWER?

All this means that an inexpensive host-based printer is an option for almost every PC user. But before you commit, you'll need to know whether your computer has enough oomph to make the cost savings worthwhile. PC Labs ran some informal tests on five host-based printers—the Brother HL-720, Canon LBP-465, and Okidata Okipage 4w lasers and the HP DeskJet 820Cse and Lexmark Color Jetprinter 2070 ink jets—to find out how much a PC's processor and memory configuration affect print speed.

The results are surprising. For example, we can't definitively say that adding RAM to your PC will always increase print speed: Much depends on the file's size and content and on how

well the printer driver handles data. When we tested printers' throughput times using our HP Pentium 90 test-bed—comparing the effects of 8MB and 16MB of RAM—we noticed that the Canon, Brother, and Okidata lasers showed the biggest increases in speed, on our smaller test files averaging around 5 percent. The speed of the HP and Lexmark ink jets hardly improved at all.

On larger, more complex files, the effects of more RAM became more evident. We saw the most dramatic differences on our Lotus Freelance file, which includes elaborate formatting as well as a gradient-fill background. The host computer's extra 8MB of memory nearly doubled the Canon printer's speed, and the HP and Okidata units also showed marked speed increases.

Will a faster CPU guarantee more rapid printing? Again, the answer depends on file type, printer driver efficiency, and the class of the system from which you're upgrading. If you're moving from a 486 without bidirectional parallel support (or the newer EPP or ECP ports) to a Pentium system, you're gaining processing speed as well as data-transfer speed. Our tests showed more dramatic increases when we moved to a Pentium 90 from a 486 without bidirectional parallel support—over 100 percent for large files—than when we shifted to a Pentium 200 from a Pentium 90. In fact, we saw major improvements in only a handful of cases when moving to the faster Pentium from the slower one.

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printer controller uses memory for various purposes, but perhaps the most important is holding the page image before it goes to the print engine. Most of the lasers in this roundup apply memory compression techniques to use controller memory more efficiently.

Both GDI and language-based printers benefit from faster communication between the computer and the printer, and now there are improved parallel ports that help speed the data transfer. The traditional, Centronics-style parallel port has a maximum data-transfer rate of about 120 to 200 KBps (kilobytes per second). The Enhanced Parallel Port (EPP) specification (developed in 1991) increased the maximum rate to 500 KBps. Microsoft, HP, and others built on the EPP specification to create the Extended Capability Port (ECP), enabling smoother performance in multitasking environments. For both GDI and language-based printers, this faster transfer rate can significantly decrease printing times, especially for pages with lots of graphical information.

There's more to the new port specifications than just speed, however. The traditional Centronics-style parallel port has eight data lines from the computer to the printer, plus four lines intended to signal printer conditions, such as online status and out-of-paper errors. These have been converted to a 4-bit-wide data channel that lets the printer identify itself to the computer when Windows starts, so that the Plug and Play feature can automatically load the correct driver.

To take advantage of the EPP/ECP features, you need to have a computer with a port that conforms to one of these standards. In many of the CMOS configuration utilities that are part of the system BIOS, you will find a choice between AT and PS/2 or ECP for parallel ports that are integrated on the motherboard. The AT setting is for the traditional Centronics-style port; to take full advantage of the newer ports' features, you'll need to select the PS/2 or ECP settings. One caution: Depending on the implementation, the ECP setting may prevent you from having other devices (such as page scanners, Zip drives, tape drives, and the

like) attached along with the printer via a pass-through parallel port. For those devices to work, you may need to switch to the AT setting.

One result of this improved communication is that front-panel controls are disappearing from the printers. Instead, you can perform all configuration tasks at the computer. The computer can poll the printer's controller for details about the current configuration, then download new settings as needed.

Many of the Windows 95 printer drivers provide extensive configuration con-

New printers benefit from faster communication between computer and printer, and now there are improved parallel ports that speed data transfer as well.

trols. Adobe's new PrintGear driver is an excellent example, but others, such as Destiny's WinStyler driver, also provide lots of options. In addition to making it easy to set basic options such as print resolution, halftone settings, and paper choices, many drivers now offer sophisticated options, including thumbnail output (multiple page images on one sheet), poster printing (a one-page image enlarged to fill many sheets), booklet formatting, and customized watermarks (faint images that print on every page).

In the final analysis, you have a strong field of contenders to consider as you shop for your next printer. Prices are lower, performance is up, and print quality is outstanding. If you need a printer as a primary output device for monochrome business correspondence, you'll probably want to stick with the reliability and unsurpassed text quality of one of the laser printers reviewed here. If you are buying a printer for a home PC or for an office PC with a network connection to a shared laser, then the added versatility of a color ink jet makes it the better choice.

INK JET PRINTERS

Alps Electric Inc.

Alps MD-2010

Low cost, good quality, and speed continue to represent the next Holy Grail for manufacturers of personal color printers. The unique printing method of the Alps MD-2010 (\$499 list, \$450 street) delivers the first two, but the printer's 1-ppm monochrome engine and 0.25-ppm color engine kiss the third goal goodbye.

Still, the four-color MD-2010 offers some unique features (such as metallic ink printing) that will attract home users and small offices with special printing needs.

Rather than using heated ink jets to put color to paper, the 600-dpi MD-2010's patented system uses four dry color ink cartridges. It heats up a printhead, which applies the inks from the ribbon-holding cartridges to the paper. You can replace the cartridges individually (at \$6.60 for a standard color cartridge and \$8.99 for a metallic ink cartridge), which keeps the cost per page low. Alps reports that a page costs 1 cent at 5 percent black coverage and 3.5 cents for color, making the MD-2010 this roundup's most inexpensive printer to run.

The unit is simple to set up and maintain, and the dry cartridges mean that there's no danger of a messy mishap. The machine can print on a variety of media, including letter-, legal-, A2-, and B5-size paper, as well as on such novelty items as black paper and iron-on transfers.

This host-based printer features 512K of memory and the ability to print at 1,200- by 600-dpi resolution in monochrome. In addition, it includes Adobe



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PhotoDeluxe, a reduced and easier-to-use version of Adobe's popular Photoshop photo editing program. Using its own language rather than PCL or PostScript, the Alps driver software lets you make a variety of adjustments from your computer, including color balance and saturation changes.

Pie charts and spot-color accents in business documents look bright and clean when handled by the MD-2010. Some users may find the waxy appearance disconcerting, but the image doesn't smudge (even right out of the printer), and the color doesn't fade in direct light. At 300 dpi, full-color images don't benefit much from Alps' unique technology. But when you bump the print resolution up to 600 dpi, the benefits become more obvious. Full-color 24-bit images look far more realistic than those from many color ink jet printers, with fully saturated and vibrant colors.

In addition, switching from 300 to 600 dpi does not hurt the printer's performance, because the printhead travels the same distance no matter what the resolution. Alps says that the machine prints color pages at 3 to 5 minutes *per page*, so it's not surprising that the printer turned in the roundup's slowest test results.

The flexibility and ease of use make the Alps MD-2010 a worthy contender in the ink jet market. Despite its slow print speed, it warrants attention from home and SOHO users looking for some fun, unique printing. —John R. Quain

Alps MD-2010. Street price: \$450. Alps Electric Inc., San Jose, CA; 800-825-2577, 408-432-6000; www.alpsusa.com. Circle 446 on reader service card.

Canon Computer Systems Inc.

Canon BJC-240, Canon BJC-4200

Canon Computer Systems introduced two new color ink jet printers this year, one of which—the BJC-240—produced the best output of the three-color printers we tested. Priced at about \$180 on the street, the BJC-240 is on the mark for its target audience as an entry-level printer and an alternative to dot matrix. Canon's \$280 BJC-4200, a competent four-color printer, is targeted at professionals who want a printer at

home. The BJC-620 (a replacement for the BJC-610) was not available for this review but will be out by the time you read this. It is a four-color printer for small business use with an emphasis on graphics printing.

Two new types of inks are available for both the BJC-240 and BJC-4200. A photo-realistic ink cartridge produces optimal photographic images on Canon's special coated stock. If you're feeling groovy, a neon ink cartridge produces output that glows under a black light.

Each printer comes with Canon Creative 2, which is both a graphical front end and a collection of printer productivity programs. There are the requisite fun projects for home and school—greeting cards, stickers, labels, certificates, T-shirt transfers, and even quilt and cross-stitch



Packaged with all Canon ink jet printers, Canon Creative 2.0 comes on two CD-ROMs. An overall menu lets you select from six applications.

patterns. But this year Canon has expanded the offerings to the needs of business users. There are ready-made templates for professional-quality (and quite handsome) brochures, stationery, menus, and more. It's easy to work with Canon Creative 2, as long as you don't mind waiting while the graphic elements load.

The Canon BJC-240 is rated at 4 ppm in monochrome printing and has a maximum resolution of 720 by 360 dpi in black with a smoothing algorithm. In color printing the maximum resolution is 360 by 360 dpi, and the speed rating drops to 0.3 ppm. The Canon Interactive Visual Guide, an online help and troubleshooting guide and user manual, alerts users to out-of-paper conditions and depleted ink supplies. Cost per page



Canon BJC-4200.

for the BJC-240 runs somewhat high in color at 12 cents a page with 15 percent coverage; it's also the highest of the tested printers, at 6 cents a page in black with 5 percent coverage.

Output quality for the BJC-240 was very good for a three-color printer. Black text was excellent, with smooth edges. Gray-scale printing produced no noticeable streaking or banding. Business color graphic printing yielded rich colors with good overall quality and only minimal streaking. With the regular color ink cartridge, photographic images were fairly smooth, though the colors were a little harsh. Switching to the photographic ink produced extremely smooth images; colors were a bit lighter but still nice when printed on the special coated stock.

The BJC-240 was, in general, faster than the other three-color printers when printing monochrome graphics but slower at printing color images. It ranked in the middle of all the tested printers on our tests for printing Microsoft Word text.

The four-color Canon BJC-4200 can print at 720 by 360 dpi in both monochrome and color modes. The BJC-4200 uses the same application software and printer utility software as the BJC-240 but offers users more choices in the printer driver menus because of its greater capabilities—such as higher-resolution settings, more halftone options, and more preset printer settings.

The BJC-4200's monochrome output samples showed extremely clear text with fine detail in gray-scale images. As with the BJC-240, the BJC-4200's special photographic inks produced very smooth output with accurate colors. When the



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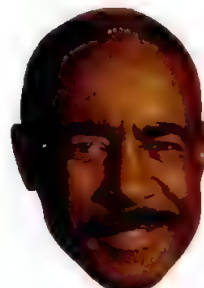
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Ink Jet Output

The black-and-white and color print quality of the new crop of ink jets has improved dramatically. Monochrome output was near laser-quality in many cases, and color samples could be downright stunning.

These samples were produced at each printer's best resolution using the high-grade ink jet stock recommended by the manufacturer. Though some of the units now offer special photographic inks for best output, we chose to judge the samples produced by the standard ink cartridges. We also stopped short of using glossy photographic paper, which at almost a dollar per sheet is simply not practical for day-to-day use.

The best output we saw was from the Epson Stylus Color 500. Its 720-dpi output and Epson's special paper combined to deliv-

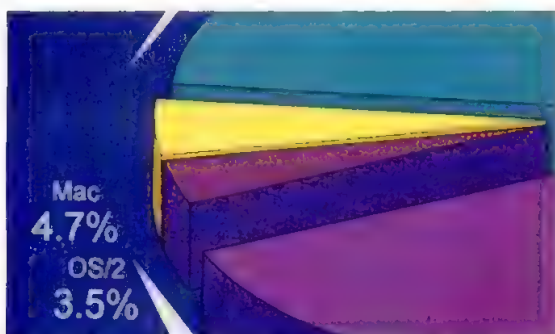
er deep, well-saturated colors with no hint of banding. The photo could pass for photo-quality at first glance, and the monochrome output was for all intents and purposes laser-quality. Close runners-up in terms of output quality were the HP DeskJet 820Cse and HP DeskJet 870Cse.

As expected, the inexpensive three-color printers trailed the others in terms of output. But if price is your most important criterion, note that the Canon BJC-240 delivered the best image quality at the low end.

The blue background should be smooth, with no banding and very little patterning.

Colors should be smooth, without visible dithering patterns or graininess.

Text should show clean edges, with no fuzziness or bleeding. Note the word *Labs* is enlarged four times.



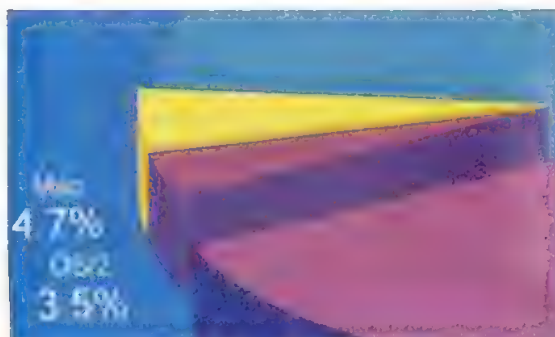
Color should be rich, with sharp text edges and clean delineation between pie slices.

Look for a printer to retain detail, even in the shadow and highlight areas of faces.

The graphic should show a good range of gray tones and retain detail throughout.

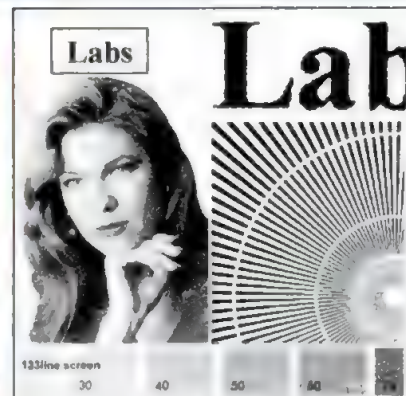
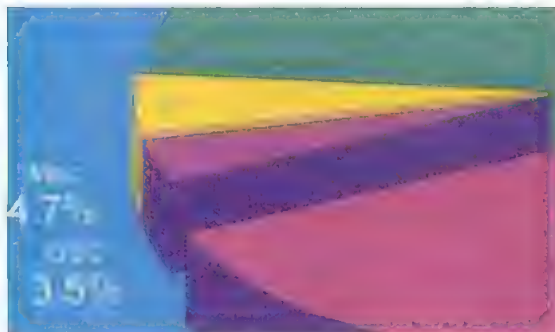
INK JET PRINTER SAMPLES

Alps MD-2010, four-color, 600-by-600 dpi

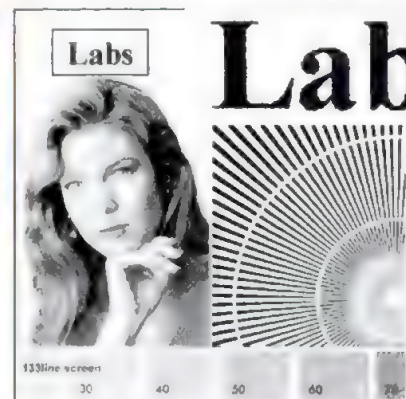
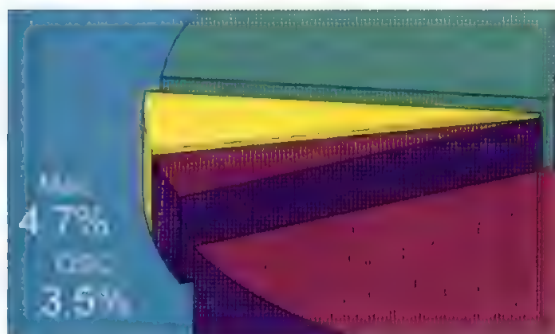


INK JET PRINTER SAMPLES

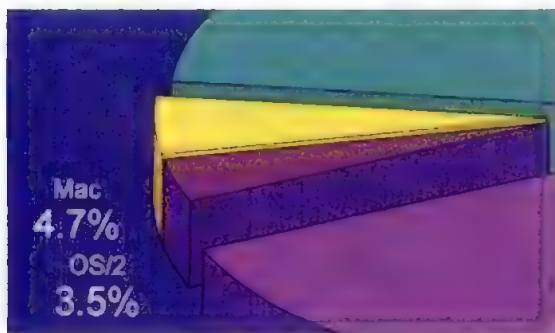
Canon BJC-240, three colors, 360 by 360 dpi



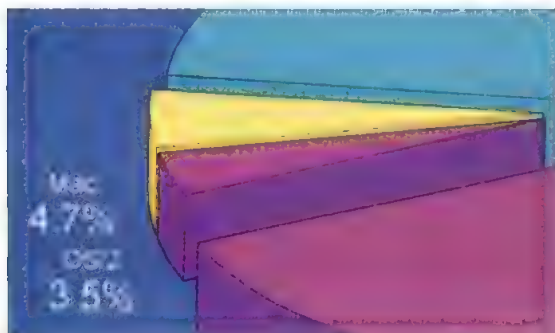
Canon BJC-4200, four colors, 720 by 360 dpi



Epson Stylus Color 500, four colors, 720 by 720 dpi



Epson Stylus Color Pro, four colors, 720 by 720 dpi



Microsoft Project

not only helps **plan**
it even nags

The screenshot displays the Microsoft Project software interface. At the top, a calendar for August 1996 is visible. Below it, a Gantt chart shows a project timeline. A task list table is also present, detailing tasks and their durations. A 'Planning Wizard' dialog box is open, displaying a cartoon character and a message about moving a task to a nonworking day. A small icon of a person's head is visible on the left side of the interface.

WBS	To Do	Time
1	Review Product	24d
1.1	Acquire review docs	2d
1.2	Read review Docs	7d
1.3	Review cost studies	14d
1.4	Planning Wizard	
2		
2.1		
3		

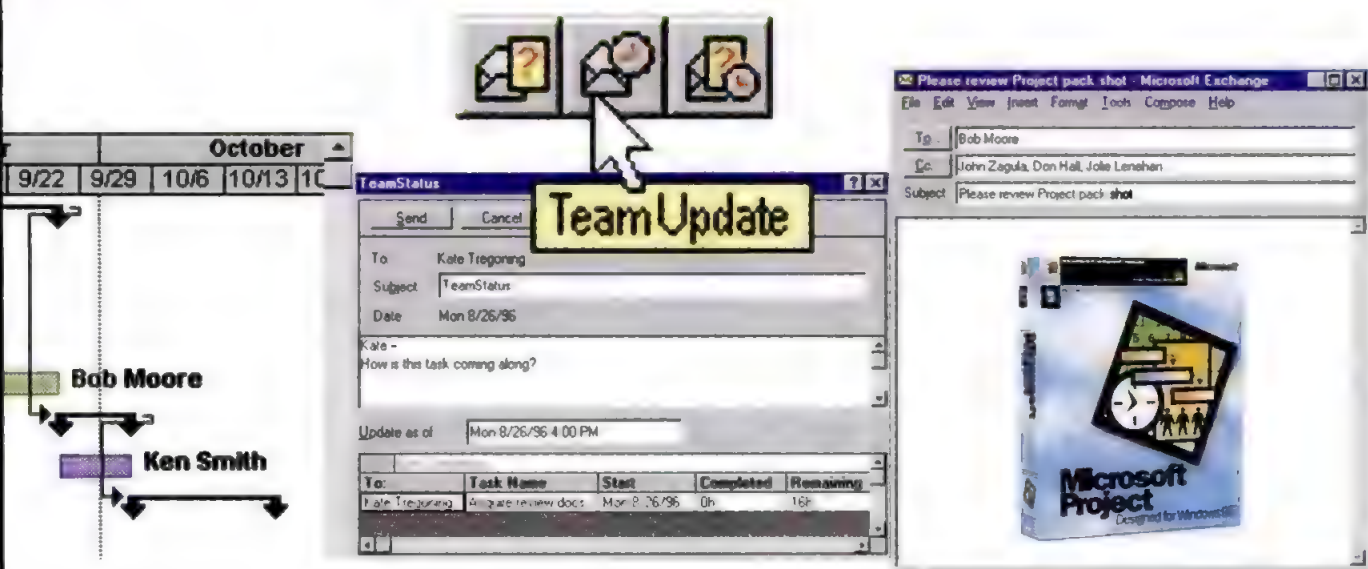
Planning Wizard

You moved 'Site Evaluation' to start on a nonworking day.

*Microsoft Project works with Microsoft Mail, cc: Mail, Lotus Notes, and the Microsoft Exchange Inbox for Windows 95.

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and manage a job, people to get it done.



Imagine one of those big white planning boards that automatically updates itself and informs you of everyone's progress and delegates tasks and just generally makes sure everything that needs to get done for your project gets done on time. That's **Microsoft® Project for Windows® 95**. Because it's part of the **Microsoft Office** family, you'll find familiar tool bars and commands that you already know how to use. **Planning wizards** walk you through every

step of planning a project, helping you figure out how to fix problems and build a better plan. You can switch your perspective from **Gantt Charts** to a **monthly calendar** view with the click of a mouse. And integration with popular **e-mail** systems* means that Microsoft Project will automatically communicate tasks, assignments and schedule changes to everyone on your team. With all of this taken care of, you can concentrate on being your usual happy-go-lucky self.

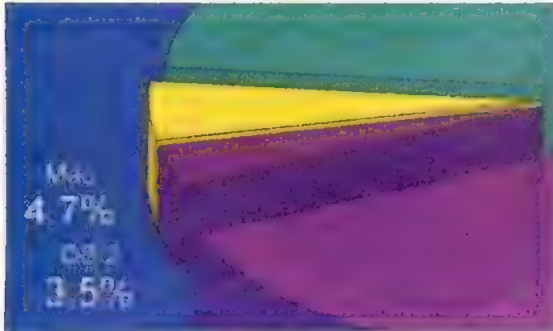
Microsoft®

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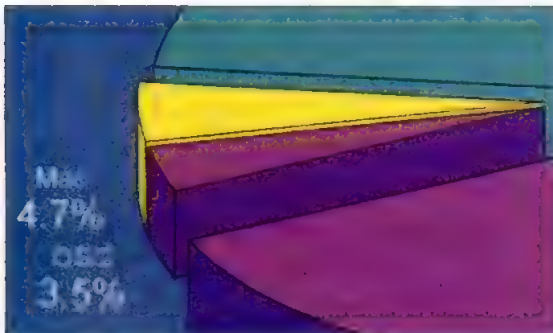
www.microsoft.com/msoffice/project/

INK JET PRINTER SAMPLES

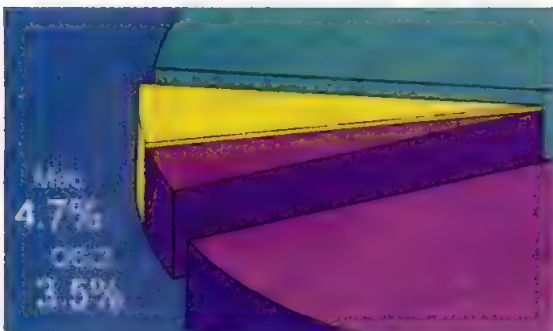
HP DeskJet 400, three colors, 300 by 300 dpi



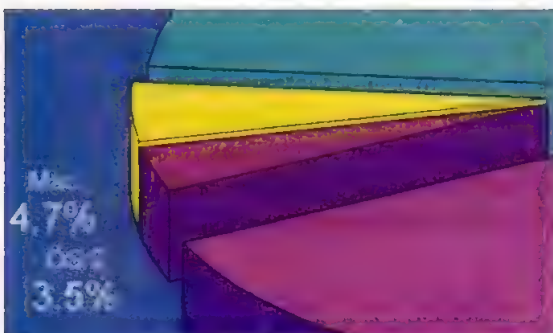
HP DeskJet 682C, four colors, 600 by 300 dpi



HP DeskJet 693C, four colors, 600 by 300 dpi

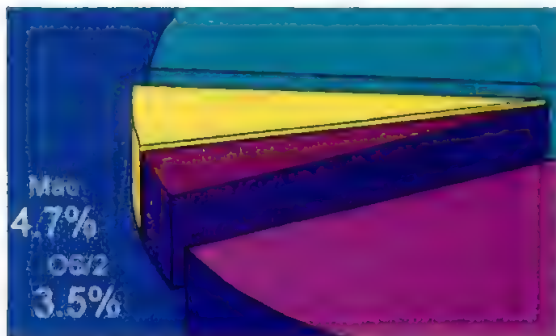


HP DeskJet 820Cse, four colors, 600 by 300 dpi

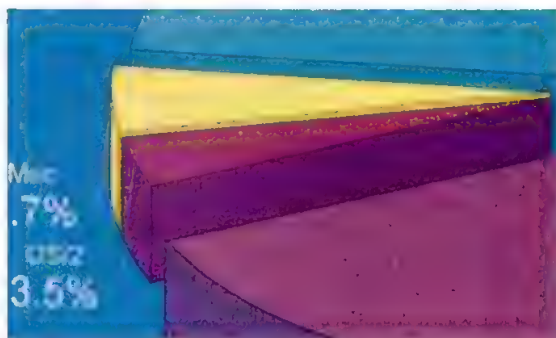


INK JET PRINTER SAMPLES

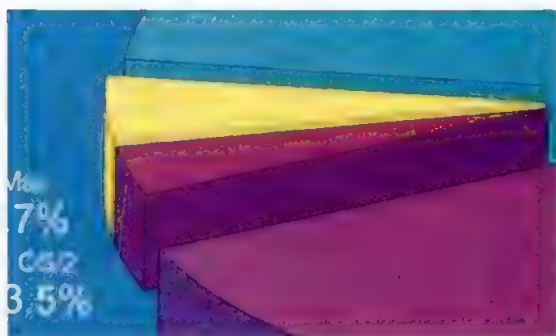
HP DeskJet 870Cse, four colors, 600 by 300 dpi



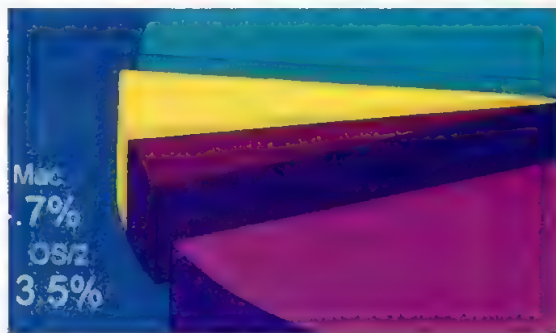
Lexmark Color Jetprinter 1020, three colors, 600 by 300 dpi



Lexmark Color Jetprinter 2050, four colors, 600 by 600 dpi



Lexmark Color Jetprinter 2070, four colors, 600 by 600 dpi



same photos were printed with the regular color ink cartridge on the special coated paper, the quality was acceptable, but the sharpness was off just a little and the difference in smoothness was apparent. If you plan to print photographic output often, you'll want to invest in the photographic ink cartridge, which costs \$50 for a kit with cartridge and case and \$42 for a replacement cartridge. The color business graphic sample showed rich, vibrant colors but had a little unexpected texturing.

On our color speed tests, the BJC-4200 was much faster than the BJC-240 but

about the same as printers from other vendors in the same price range. Its print nozzles in black (\$128, versus \$48 for the competitors) resulted in slower times, though output quality was better. The Canon BJC-240 is a good little printer for the price. The Canon BJC-4200 is another competent model and a significant step up in print quality.—*Bruce Brown*

Canon BJC-240. Street price: \$179. **Canon BJC-4200.** Street price: \$279. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 408-945-1135; www.ccsi.canon.com. Circle 448 on reader service card.

Epson America Inc.

Epson Stylus Color 500, Epson Stylus Color Pro



Epson America debuts two new ink jet printers this year: the \$280 (\$329 list) Epson Stylus Color 500 and \$380 (\$499 list) Epson Stylus Color Pro. The Stylus Color 500 is a four-color printer with a maximum 720-dpi resolution in both black and color (on special paper) and is intended for home and small business use. The Stylus Color Pro is specifically aimed at business and

Desktop FotoMat: Fargo FotoFun! and Fujix PrintIt

Until recently, getting photofinisher-quality snapshots from your computer meant buying an expensive printing device aimed at service bureaus and professional photographers. Now Fuji Electronics and Fargo Electronics offer printers that produce truly photo-realistic, snapshot-size prints that look as if they came out of the darkroom. Fuji's is intended for amateur photographers and professional graphic artists; Fargo's is so inexpensive that even the casual PC user may want to purchase one for the family PC.

The first thing you'll notice about the Fujix PrintIt (\$699 list, \$600 street) is the absence of ribbons or ink cartridges. Fuji's proprietary Thermo-Autochrome technology embeds color into its special photosensitive paper, and the unit "develops" images with light and heat. The PrintIt is also a hybrid video printer. You can attach it

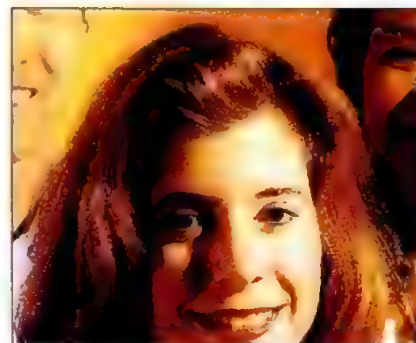


The Fujix PrintIt's output was good ...

simultaneously to a computer and a TV set, camcorder, or VCR to capture and print still images easily.

Setup, installation, and the loading of media are simple. The printer can take up to ten sheets of paper at a time, and the average time per print is about 2 minutes. The prints look like glossy photographs. Colors are bright and realistic, and images appear detailed with just a hint of fuzziness.

Fargo's FotoFun! (\$599 list, \$500 street) is a conventional if miniature thermal dye printer that uses a three-color cellophane ribbon to heat-emboss images onto 4- by 7-inch paper. It takes a single, hand-fed sheet at a time, and like the Fujix, it prints in about 2 minutes. In addition to regular glossy paper, Fargo offers postcard paper, as well as transfer kits



...but the Fargo FotoFun's was better.

for making labels for ceramic mugs.

Whereas the PrintIt has various buttons and status lights, the FotoFun! has only two. That makes it difficult to pinpoint problems (such as the end of a ribbon or a paper jam). But installing the software and ribbons is easy, and once you get the hang of it, so is feeding in the paper.

The FotoFun! produced beautiful prints. They were larger and more detailed than the PrintIt's, and the colors were more saturated and more accurate. Also, unless you need the PrintIt's video output capability, with a street price of \$400, the FotoFun! is hundreds of dollars cheaper than the PrintIt.

But before you abandon the mall minilab, note that on top of the cost of the units, you pay about a buck for each PrintIt and FotoFun! print. Your friendly photofinisher charges about 15 to 30 cents.—*Daniel Grotta and Sally Wiener Grotta*



Fuji and Fargo Printers.

After the
Revolution
there was
Gateway!

 **GATEWAY2000**

"You've got a friend in the business."

The Revolution Begins Here!

When patriots threw 342 chests of British tea into Boston Harbor on December 16, 1773, the ripple extended all the way to England. A small act of defiance. The Boston Tea Party nonetheless sent a big message to an absentee British ruler later indicted for having "plundered our seas, ravaged our coasts, burnt our towns and destroyed the lives of our people."

When two Midwestern farm boys created the first ever GATEWAY 2000® PC more than two centuries later, their defiance against high prices rumbled throughout an industry. It was the birth of the PC revolution.

Since then Gateway has held these truths to be self-evident: Customers deserve quality, value and the commitment of customer service.

Our Gateway Solo™ 2100 series is but the latest salvo in the revolution. It empowers the masses to break free with its Intel Pentium® processors — including the new 150MHz processor — up to 12.1" Active Matrix SVGA color display, at least 16MB EDO RAM, zoomed video port and 6X modular CD-ROM drive.

Gateway's revolutionary spirit rages on, urging everyone to challenge the limits of human achievement — and overcome them.





GATEWAY2000

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The
Revolution in Technology
is *Power* to the *People.*



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Revolutions have always been about delivering power to the people. In keeping with that tradition, we offer our Pentium® Pro processor-based G6-200XL multimedia systems and G6-180 professional systems.

Our custom-configured G6 systems take advantage of the Pentium Pro processor's advanced design to squeeze every bit of breathtaking speed and performance out of the new generation of 32-bit software. The Pentium Pro also delivers high performance on today's 16-bit applications.

In fact, tests show the 180MHz Pentium Pro processor posts better overall benchmarks than a comparable 200MHz Pentium system for about the same price.™ Exercise your freedom to choose, call Gateway 2000 today.

The GATEWAY 2000 PC revolution delivers computer buyers free from the limited choices and high costs of yesterday's industry rulers. People stand at the center of the revolution, providing both the power and the light and the cause for which it is waged.

Witness our desktop systems. Our sales professionals will help you custom-configure your system from available options. You can also choose from many software and operating system options, and then have the system shipped right to your door, ready to use. Such customer-centered service has captured the hearts of the people. Soon they'll expect other companies to follow Gateway's example, thus transforming an industry.

...with *Service* and *Value* for *All!*



The American revolution, born of small acts of defiance and insurrection and nurtured through the spirit of people it sought to empower, crystallized on July 4, 1776, when the Founding Fathers set down their historic Declaration of Independence.

More than two centuries later, Gateway affirms that our PC revolution remains focused on human need by establishing a Customer Declaration of Independence.

Customer focus led to Gateway's development of a whole new kind of computer, the Destination™ Big Screen

C U S T

Declaration

When in the course of human affairs, computer products to enhance the lives of the purveyors of such products to meet co

Therefore,

KNOWLEDGE being key to manufacturers shall employ sales representatives to freely offered information.

PC COMPANIES shall not re technology at outstanding prices.

BEING THE BEST JUDGES shall have the right to purchase a PC available options.

CUSTOMERS shall have the r properly upon delivery.

THE RIGHT to knowledgeab in a timely fashion and sensitive to cus

ACKNOWLEDGING that P of customers, the customers' needs sh within the evolution of the personal co

We the most senior officers of Gate certain management principles that prom customers and, through the working of th

John Allen Taylor Richard
Bob Back
Rm Qua

PC. An alliance between the PC and television, the Destination system is yet greater than the sum of those parts. Its powerful computer heart, huge 31-inch-diagonal screen and television capabilities make it truly a servant of the people, especially when they assemble in groups.

By declaring itself free of self-limiting thought, Gateway 2000 developed a whole new category of computer, while reaffirming its devotion to service and value. Thus the PC revolution — a revolution sustained by the people it serves — marches on.



GATEWAY
"You've got a fr

800-846

Multimedia Systems

P5-133 FAMILY PC

- Intel® 133MHz Pentium® Processor
- 16MB Synchronous DRAM
- CrystalScan™15 .28dp Monitor (13.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 1GB 10ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 16-Bit GATEWAY™ Sound
- Altec™ Lansing ACS-40 Speakers
- TelePath® 33.6* Data/14.4 Fax Modem for Windows with Speakerphone
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- Microsoft® Windows® 95
- Generations II Software Collection

\$1699

P5-166 FAMILY PC

- Intel 166MHz Pentium Processor
- 16MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan17 .28dp Monitor (15.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 2GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 16-Bit Gateway Sound
- Altec Lansing ACS-40 Speakers
- TelePath 33.6* Data/14.4 Fax Modem for Windows with Speakerphone
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

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G6-180 FAMILY PC

- Intel 180MHz Pentium Pro Processor
- 32MB EDO DRAM
- 256K Internal Cache
- Vivitron17™ .26dp Monitor (15.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 2GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 16-Bit Ensoniq® Wavetable Sound Card
- Altec Lansing ACS-40 Speakers
- TelePath 33.6* Data/14.4 Fax Modem for Windows with Speakerphone
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

\$2649

G6-200XL

- Intel 200MHz Pentium Pro Processor
- 32MB EDO DRAM
- 256K Internal Cache
- Vivitron17 .26dp Monitor (15.9" viewable)
- Matrox® 2MB WRAM PCI Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- CD-Recordable w/ SCSI Controller
- 16-Bit Ensoniq Wavetable Sound Card
- Altec ACS-400 & ACS-250 Speakers
- TelePath 33.6* Data/14.4 Fax Modem with Speakerphone
- 12-Bay Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition
- Generations II Software Collection

\$3699 Business Lease* \$136/mo.

Professional Systems

P5-133

- Intel 133MHz Pentium Processor
- 16MB Synchronous DRAM
- CrystalScan15 .28dp Monitor (13.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 1GB 10ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$1599 Business Lease* \$59/mo.

P5-166

- Intel 166MHz Pentium Processor
- 16MB Synchronous DRAM
- 256K Pipelined Burst Cache
- Vivitron17 .26dp Monitor (15.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 2GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$2199 Business Lease* \$81/mo.

P5-200

- Intel 200MHz Pentium Processor
- 32MB Synchronous DRAM
- 256K Pipelined Burst Cache
- Vivitron17 .26dp Monitor (15.9" viewable)
- 2MB DRAM, 64-Bit PCI Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

\$2549 Business Lease* \$94/mo.

G6-180

- Intel 180MHz Pentium Pro Processor
- 32MB EDO DRAM
- 256K Internal Cache
- Vivitron17 .26dp Monitor (15.9" viewable)
- 2MB DRAM, 64-Bit Graphics
- 3GB 11ms EIDE Hard Drive
- 8X CD-ROM/3.5" Diskette Drives
- 7-Bay Mini Tower Case
- 104* Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition

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Gateway Solo™ 2100 Portable PCs

S5-120

- 11.3" DSTN SVGA Color Display
- Intel 120MHz Pentium Processor
- 16MB EDO DRAM expandable to 40MB
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Zoomed Video Port
- 810MB Hard Drive
- Modular 6X CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Sound & Stereo Speakers
- Lithium Ion Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95
- MS Works 95

\$2699 Business Lease* \$99/mo.

S5-133

- 12.1" Active Matrix SVGA Color Display
- Intel 133MHz Pentium Processor
- 24MB EDO DRAM expandable to 40MB
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Zoomed Video Port
- 1.3GB Hard Drive
- Modular 6X CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Sound & Stereo Speakers
- Lithium Ion Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95
- MS Office 95, Professional Edition

\$3899 Business Lease* \$143/mo.

S5-133 Best Buy

- 12.1" Active Matrix SVGA Color Display
- Intel 133MHz Pentium Processor
- 40MB EDO DRAM
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Zoomed Video Port
- 1.3GB Hard Drive
- Modular 6X CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Sound & Stereo Speakers
- 28.8 PCMCIA Fax/Modem
- Lithium Ion Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95
- MS Office 95, Professional Edition

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*Maximum data transfer rate dependent on certain variables including particular modems with which you are communicating telephone lines, communications software, and communications protocols.



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- **SMC® PCI 10/100 Twisted Pair Card \$129**
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- Upgrade 133MHz to 150MHz Intel Pentium Processor \$150



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SUMMARY OF FEATURES

Personal Ink Jets

PC MAGAZINE
EDITORS' CHOICE

■ YES ■ NO □ OPTIONAL

Products listed in alphabetical order

	Alpa MD-2010	Canon BJC-240	Canon BJC-4200	Epson Stylus Color 500	Epson Stylus Color Pro	HP DeskJet 400	HP DeskJet 682C
List price/Street price	\$499, \$450	N/A, \$180	N/A, \$280	\$329, \$280	\$499, \$380	\$248, \$200	\$370, \$300
Dimensions (HWD, in inches)	7.4 x 17.0 x 8.8	6.5 x 14.2 x 6.8	7.5 x 15.1 x 11.5	7.8 x 17.0 x 9.8	7.2 x 19.0 x 20.9	13.7 x 6.4 x 7.0	7.9 x 17.2 x 16.0
Weight (pounds)	17.2	5.5	7.0	11.0	18.5	8.6	14.3
Number of colors used in color printing	4	3	4	4	4	3	4
Number of jets (black/color)	N/A	64, 48	128, 72	64, 60	64, 48	50, 48	48, 40
Maximum monochrome resolution (dpi)	1,200 x 600	720 x 360	720 x 360	720 x 720	720 x 720	600 x 300	600 x 600
Maximum color resolution (dpi)	600 x 600	360 x 360	720 x 360	720 x 720	720 x 720	300 x 300	600 x 300
Rated monochrome speed/color speed (ppm)	1, 0.25	4, 0.3	5, 1	4, 1	3, 1	3, 0.7	5, 1.5
Parallel port/serial port	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Macintosh-compatible	■	■	■	■	■	■	■

Paper Handling and Software

Paper input capacity (number of sheets)	100	100	100	100	100	50	100
Prints on card stock/transparencies	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Prints on 8-size paper/envelopes	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Paper paths	Straight	L, straight	L, straight	L	U	L, straight	U
PCL support	None	None	None	None	None	PCL 3	PCL 3
Host-based processing	■	■	■	■	■	■	■
"Low ink" alert (hardware/software)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Application software included	Adobe PhotoDeluxe	Canon Creative 2.0	Canon Creative 2.0	Adobe PhotoDeluxe, Sierra Print Artist	Adobe PhotoDeluxe, Sierra Print Artist	None	Mickey & Friends Print Studio

Color Features and Customer Support

Automatic color analysis	■	■	■	■	■	■	■
User can control colors	■	■	■	■	■	■	■
Cost per high-capacity black ink cartridge	\$6.60	\$30.00	\$29.00	\$23.50	\$16.20	\$32.95	\$32.95
Cost per color cartridge	\$8.99	\$37.00	\$50.00	\$28.50	\$32.00	\$34.95	\$34.95
Rated cost per page (5% black coverage)	1 cent	6 cents	4 cents	4 cents	2 cents	3 cents	3 cents
Rated cost per page (15% color coverage)	3.5 cents	12 cents	11 cents	9 cents	5 cents	23 cents	8 cents
Toll-free technical support	■	■	■	■	■	■	■
Technical support hours (eastern time)	8:30-5:00 M-F	6:00 A.M.-midnight, 7 days	6:00 A.M.-midnight, 7 days	9:00-9:00, 7 days	9:00-9:00, 7 days	8:00 A.M.-midnight M-F	8:00 A.M.-midnight M-F
Warranty (parts and labor)	1 year	1 year	1 year	2 years	2 years	1 year	1 year
Overnight exchange for warranty service	■	■	■	■	■	□	□

N/A—Not applicable. The product does not have this feature.

home users who want great graphics, especially on plain paper, with very low per-page costs. Both of the tested Epsoms are fine printers; the Stylus Color 500 is a showstopper.

The Epson ink jets use piezoelectric print technology, which creates less heat buildup and offers finer dot control than standard thermal ink jet technology. Epson's new Color Pak, bundled with each printer, includes Sierra On-Line's Print Artist and Adobe PhotoDeluxe. Print Artist helps you design cards, signs, banners, and calendars via a library of templates and graphics. PhotoDeluxe is an easy-to-use image editing package.

On our output quality tests, the Stylus Color 500 was one of the top printers in this roundup. The Stylus Color 500 is unique in Epson's line in using new super-

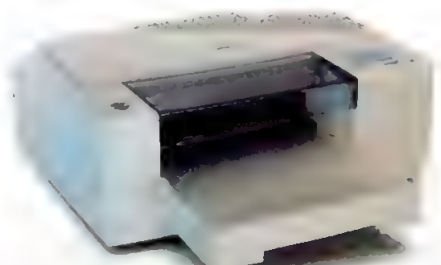
penetrating black and color inks that are dye-based rather than pigment-based. These inks sink deeper into the paper, look richer, and dry faster than conventional pigment-based inks.

On monochrome printing, the Epson Stylus Color 500 creates text that looks as good as a laser printer's and gray-scale images that are extremely clear and fine. The only other printer in this group that produced equally good monochrome gray-scale output was the Epson Stylus Pro. The business graphic test sample (printed on high-grade coated stock) had the richest, most vibrant colors of the test group. On the color photograph, dots were visible in the background, but faces printed out smoothly and the colors were solid and consistent.

You can't have it both ways with this

printer: You can get great output at relatively slow speeds or good output at average speeds. For example, printing speed was good but not outstanding on application tests in default 360-dpi mode, but the times slowed when the Stylus Color 500 was run in the 720-dpi mode that produced the terrific output.

The Stylus Color Pro is unique in its ability to print at 720 dpi on plain paper,



Epson Stylus Color Pro.

COVER STORY
Personal Printers

PC MAGAZINE
EDITORS' CHOICE

HP DeskJet 693C	HP DeskJet 820Cse	HP DeskJet 870Cse	Lexmark Color Jetprinter 1020	Lexmark Color Jetprinter 2050	Lexmark Color Jetprinter 2070
\$431, \$350	\$485, \$400	\$599, \$500	\$189, \$150	\$299, \$250	\$419, \$350
17.2 x 7.9 x 16.0	8.9 x 17.5 x 15.8	8.9 x 17.5 x 15.8	7.8 x 14.2 x 8.2	11.7 x 17.0 x 10.0	11.7 x 17.2 x 11.1
11.6	14.3	14.3	9.0	9.8	11.0
4	4	4	3	4	4
48, 48	48, 48	48, 48	56, 48	56, 48	104, 96
600 x 600	600 x 600	600 x 600	600 x 300	600 x 600	600 x 600
600 x 300	600 x 300	600 x 300	600 x 300	600 x 600	600 x 600
5, 1.7	6.5, 4	8, 4	2, 0.5	4, 0.5	5, 1
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■
100	150	150	100	150	150
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
U	U	U	L	L	L
PCL 3	PCL 3	PCL 3	None	None	None
■	■	■	■	■	■
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Mickey & Friends Print Studio	50 TrueType Fonts, Microsoft Publisher	From Start to Business	Corel 4	Workshop	Corel 4
■	■	■	■	■	■
■	■	■	■	■	■
\$32.95	\$32.95	\$32.95	\$32.95	\$32.95	\$35.95
\$34.95	\$35.95	\$35.95	\$38.95	\$38.95	\$39.95
4 cents	3 cents	3 cents	3 cents	3 cents	3 cents
11 cents	8 cents	8 cents	17 cents	20 cents	20 cents
■	■	■	■	■	■
8:00 A.M.-midnight M-F	8:00 A.M.-midnight M-F	8:00 A.M.-midnight M-F	10:00-7:00 M-F	10:00-7:00 M-F	10:00-7:00 M-F
1 year	1 year	1 year	2 years	1 year	1 year
□	□	□	■	■	■

producing outstanding output, particularly in monochrome gray-scale mode. The cost leader at 2 cents a page with 5 percent black coverage and 5 cents a page with 15 percent color coverage, the Stylus Color Pro will quickly earn back its higher price in applications where it sees moderate to heavy use.

The Stylus Color Pro prints with extremely small dots (what Epson calls its Microdot technology) to create smooth, high-resolution images. As with the Stylus Color 500, the Stylus Color Pro's black output looks like laser quality. In color photographic printing, the higher resolution capability pays off with very smooth images. In color business graphic printing the Stylus Color Pro had rich colors, but they didn't look as deeply saturated as those from the Stylus Color 500. There was also

minor banding and some visible patterning in what should have been solid areas.

The Stylus Color Pro, like the Stylus Color 500, prints faster in default 360-dpi mode than in 720-dpi mode, but the performance cost of switching up to the higher resolution is not as great as with the lower-end model. Overall, performance times were about average for the group.

Epson's Stylus printers deliver on print quality, in both monochrome and color. While the best results are obtained with Epson's own 720-dpi paper, which at \$10 for 100 sheets costs 10 cents a page, even in plain paper the output is fine for everyday and draft work. The eye-popping output quality of the Stylus Color 500 sets a new target for other printer vendors to emulate, while the Stylus Color Pro's plain-paper 720-dpi



Print Artist, packaged with the Epson Stylus Color Pro and Stylus Color 500, lets you select from a menu of printing tasks.

printing is a cost-saving high note.—*BB*
Epson Stylus Color 500. List price: \$329. Street price: \$280. **Epson Stylus Color Pro.** List price: \$499. Street price: \$380. Epson America Inc., Torrance, CA; 800-463-7766, 310-782-0770; www.epson.com. Circle 449 on reader service card.

Hewlett-Packard Co.

HP DeskJet 400,
HP DeskJet 682C,
HP DeskJet 693C,
HP DeskJet 820Cse,
HP DeskJet 870Cse



Hewlett-Packard has been putting a lot of resources into the ink jet printer market; this year the company introduced five new models.

The HP DeskJet 400 (\$248 list price, \$199 street) is a small three-color printer intended as a dot matrix printer replacement for entry-level users. The DeskJet 682C (\$370 list, \$300 street) is a four-color printer that can print banners on fanfold paper and comes with family-oriented software. The DeskJet 693C (\$431 list, \$350 street) shares most of the 682C's features and can also use new photographic ink cartridges that effectively give you six-color printing.

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Echos P100C

100MHz Pentium processor, 8MB std./40MB max RAM, 11.3" DSV display,
PCI Bus, 256K L2 cache, 1.3GB removable HDD, 800x600 SVGA resolution,
Multi-function bay: 6X CD-ROM and modular FDD (std.), second battery (opt.)

\$2,299*



Echos P100E

100MHz Pentium processor, 8MB std./40MB max RAM, 10.4" TFT display,
PCI Bus, 256K L2 cache, 1.3GB removable HDD, 800x600 SVGA resolution,
Multi-function bay: 6X CD-ROM and modular FDD (std.), second battery (opt.)

\$2,799*



Echos P120E

120MHz Pentium processor, 8MB std./40MB max RAM, 11.5" TFT display,
PCI Bus, 256K L2 cache, 1.3GB removable HDD, 800x600 SVGA resolution,
Multi-function bay: 6X CD-ROM and modular FDD (std.), second battery (opt.)

\$3,599*



Echos P133S

133MHz Pentium processor, 16MB std./40MB max RAM, 11.8" TFT display,
PCI Bus, 256K L2 cache, 1.3GB removable HDD, 800x600 SVGA resolution,
Multi-function bay: 6X CD-ROM and modular FDD (std.), second battery (opt.)

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PERFORMANCE TESTS

Personal Printers



Though none of the printers lived up to their vendors' engine-speed claims on our tests, those claims did predict relative performance.

But results were so similar that you should give other factors, such as output quality and features, more weight.

What the Numbers Mean

Ink Jets Analyzing ink jet performance presents an unusually difficult challenge, because there are many important factors. For example, the number of printhead nozzles for monochrome and color affects the size of the band that lays down ink in a single pass. The printhead's speed across the page results partly from how often it fires the nozzles. Also, performance depends partly on ink properties, such as surface tension (which influences both the printhead's ability to saturate surfaces and the ink's drying time) and viscosity (which affects how quickly ink can refill the head chambers).

Software driver efficiency and the settings for levels of output quality also have a great impact. For instance, Canon Computer Systems' "automatic" setting works in 24-bit mode to allow for photograph images. If you set the driver to "text and graphics," however, it converts to 3-bit mode, which is faster. A typical ink jet driver also includes speed, quality, and resolution settings, as well as a setting that lets you conserve toner.

On our Microsoft Word for Windows test at 300- by 300-dpi resolution, Lexmark International's four-color Color Jetprinter 2070 was the top performer. The unit performed better than its four-color counterpart, Lexmark's Color Jetprinter 2050. This is probably because the former model has twice as many black jets, which means its printhead can cover more surface area during each pass over the paper.

The Alps MD-2010 was not as quick as other 300- by 300-dpi printers, but its technology is very different. Typical thermal ink jets employ a process called *nucleation*, during which rapidly heated ink forms an expanding vapor bubble that expels a tiny droplet through a nozzle. By contrast, the MD-2010 heats the printhead, allowing the ink to melt and then harden on the paper. The printhead also lays down colors one at a time in a total of four passes, which explains this unit's slow speed. This printer is meant for graphics-oriented users who care more about quality than about speed.

The HP DeskJet 400, HP DeskJet 682C, HP DeskJet 693C, and HP DeskJet 820Cse default to 300- by 600-dpi resolution for a monochrome document, such as our Word file. All use the PCL 3 language and interpreter except for the 820Cse, which uses the HP Printing Performance System host-based driver. We believe this host-based system allowed the 820Cse to score above its siblings. In 360- by 360-dpi mode, the Epson Stylus Color 500, Epson Stylus Color Pro, and Canon BJC-240 all produced similar throughput results.

On our Microsoft Excel for Windows test, the HP DeskJet 820Cse host-based printer and the HP DeskJet 870Cse PCL 3 were the top performers in 300- by 300-dpi mode. The Epson Stylus Color Pro also scored well, printing the test document in less than 3 minutes—which compares with more than 4 minutes for most of the ink jets. The poorest performers were the Canon BJC-240 and the Alps MD-2010.

On our Microsoft Publisher for Windows test, the top two performers in 300- by 300-dpi mode were Lexmark's Color Jetprinter 2070 (using host-based drivers) and the HP DeskJet 870 Cse (using PCL 3). The HP unit has three times as many nozzles as the Color Jetprinter 2070, but remember that the latter unit gains efficiency from being host-based; its printer driver receives GDI commands from Windows, converts the graphics primitives to raw raster data, and sends the bitmapped stream to the printer. We can partly attribute the machine's speed to its use of our test-bed's 90-MHz Pentium processor as its rasterizing engine. The HP DeskJet 820Cse, HP DeskJet 682C, and Epson Stylus Color Pro performed about the same, printing the test document in less than 3 minutes. The other ink jets took more than 3 minutes to print, with the slowest being Lexmark's Color Jetprinter 2050 and the Alps MD-2010.

On our Freelance Graphics for Windows test, the top performer once again was the HP DeskJet 870Cse, running in 300- by 300-dpi mode and employing PCL 3. Its time of 6 minutes, 19 seconds was one-half to one-third what the other printers managed. The HP DeskJet 400, the HP DeskJet 820Cse, and the Epson Stylus Color Pro also did fairly well. The remainder of the printers took well over 10 minutes to produce our complex, full-color, three-page file.

Lasers On our Microsoft Word for Windows test, two 600-dpi, 8-ppm laser printers posted the top scores: the NEC SuperScript 860 (using Adobe's new 50-MHz PrintGear Imaging processor and a 16-MHz Motorola 68EC000 coprocessor) and the new HP LaserJet 6P (using PCL 5e with an HP C3980x1 engine and an Intel 24-MHz

INK JET PRINTERS

	Microsoft Word for Windows (monochrome, 5 pages)	Microsoft Excel for Windows (monochrome, 2 pages)
Minutes:seconds		
Alps MD-2010	6:02	2:49
Canon BJC-240	2:29	1:28
Canon BJC-4200	3:12	1:40
Epson Stylus Color 500	2:17	1:08
Epson Stylus Color Pro	2:24	1:08
HP DeskJet 400	3:02	1:43
HP DeskJet 682C	3:18	1:53
HP DeskJet 693C	2:24	2:13
HP DeskJet 820Cse	2:13	2:56
HP DeskJet 870Cse	1:48	1:28
Lexmark Color Jetprinter 1020	3:42	1:51
Lexmark Color Jetprinter 2050*	2:05	1:16
Lexmark Color Jetprinter 2070	1:32	1:24
	◀ BETTER	◀ BETTER

* We tested this printer with EMF spooling enabled, because it offers no way to disable the spooling

RISC processor). The 8-ppm HP LaserJet 6MP trailed its PCL fraternal twin, because its PostScript Level 2 language processes simple print jobs more slowly than PCL. The 8-ppm Xerox DocuPrint 4508, using PCL 5e, was disappointing. This may be partly due to the early driver versions that were available at the time of our testing. In addition, this unit has to emulate the PCL 5e language, which may not be very efficient at handling heavily formatted documents. When given the same document without formatting, it printed much more quickly.

The 6-ppm Panasonic KX-P6500, running at 600 dpi, also scored well. It uses a host-based driver that took advantage of our test-bed's 90-MHz Pentium processor, and it efficiently compresses data at the host and decompresses it at the printer. The 6-ppm Brother HL-720 and Brother HL-730, which also compress data at the host and decompress at the printer, were nearly tied with the 6-ppm Okidata OL610e (which uses PCL 5e with an Okidata LED engine and a 25-MHz MIPS 3000 RISC processor). The 6-ppm Lexmark Optra E (with PCL 5e) and the Lexmark Optra Ep (with PostScript Level 2), using a Minolta engine with a 16-MHz AMD 29205 RISC processor, were the two slowest contenders. In order to print our test document at 600 dpi on the Optra E, we had to add memory to the machine, which comes standard with 2MB. The 4-ppm printers—the TI microLaser WIN/4, Okidata Okipage 4w, HP LaserJet 5LXtra, and Canon LBP-465—all use host-based drivers and scored within seconds of each other.

On our Microsoft Excel for Windows test, the Panasonic KX-P6100 performed best but produced lower-quality, 300-dpi output. The top 600-dpi scores were in the 8-ppm category, posted by the LaserJet 6P and the NEC SuperScript 860. The 6-ppm, 600-dpi Panasonic KX-P6500 beat out the 8-ppm HP LaserJet 6MP. The host-based, 6-ppm NEC SuperScript 660, Brother HL-720, and Brother HL-730 were slightly faster than the language-based, 6-ppm Okidata OL610e and the 8-ppm Xerox DocuPrint 4508. Once again, the 6-ppm Lexmark Optra E (PCL5e) and Lexmark

Optra Ep (PostScript Level 2) were far behind the rest of the pack, probably because of the design of their PCL 5 interpreters and Minolta engines.

Four 6-ppm, host-based printers did the best on the Microsoft Publisher test: the Panasonic KX-P6100 (running at 300 dpi), the Panasonic KX-P6500 (600 dpi), and the Brother HL-720 and Brother HL-730 (600 dpi each). We believe this was because we used a complex document, which these host-based printers could handle better than others simply by compressing and decompressing the data; traditional, PostScript-based, and PCL-based printers had to decipher and encode it.

The 8-ppm Okidata OL600e, using PCL 4.5 and producing 600-dpi-class output (1,200-by-300), also did well. This was because of its LED engine, its 25-MHz MIPS 3000 RISC processor, and its exemplary drivers, which helped it beat both the 8-ppm NEC SuperScript 860 (using PrintGear) and the 8-ppm HP LaserJet 6P (using PCL 5e). The new Okidata Okipage 4w led the 4-ppm category, followed closely by the HP LaserJet 5LXtra. Both of these printers employ proprietary host-based drivers that helped them outperform the TI microLaser WIN/4 and the Canon LBP-465, which use Microsoft's Windows Printing System (WPS).

The 8-ppm Xerox DocuPrint 4508's score was disappointing; even more so were the scores of the 6-ppm Lexmark Optra E and Lexmark Optra Ep, which lagged far behind all the other scores.

Like the Microsoft Publisher for Windows test, the complex Lotus Freelance Graphics for Windows test was also handled best by 6-ppm, host-based printers: the Panasonic KX-P6100 (at just 300 dpi), the Brother HL-720 and Brother HL-730 (600 dpi each), and the NEC SuperScript 660 (600 dpi). The 4-ppm Okidata Okipage 4w performed well, beating all of the 8-ppm printers except the HP LaserJet 6P. Once again, the Xerox DocuPrint 4508 was at the bottom of the pack, beating only the Lexmark Optra E and Optra Ep.—*Analysis written by Laura Cox*

How We Tested

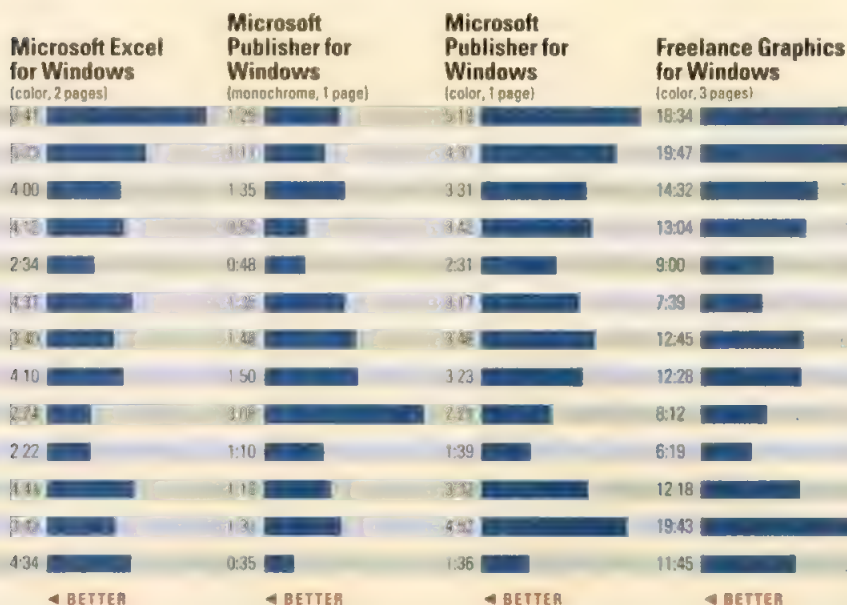
The **Microsoft Word for Windows** test times the printing of a five-page monochrome text document that uses different fonts and typefaces.

The **Microsoft Excel for Windows** test times the printing of a two-page spreadsheet document containing a line chart and 3-D bar graphs and pie charts. We printed the document in color on the ink jet printers and in monochrome on the laser printers.

The **Microsoft Publisher for Windows** test times the printing of a one-page monochrome newsletter containing text, graphics, and a bitmapped photo. We printed the document in both color and monochrome on the ink jet printers and in monochrome on the lasers.

The **Freelance Graphics for Windows** test times the printing of a complex, three-page presentation document (4.5MB) that includes a gradient-fill background with bitmapped images, shaded text, shaded

Continues



PERFORMANCE TESTS

Continued

boxes, and other elements. We printed the document in color on the ink jet printers and in monochrome on the laser printers.

We performed tests on an HP Vectra Pentium/90 with 16MB of RAM, using a 1GB Quantum hard disk and running Windows 95. We set the HP BIOS to ECP to comply with the 1284 IEEE standard and to allow bidirectional printing. We tested the printers at their default resolutions and driver settings. We chose to print directly to the printer to attempt to isolate the printer hard-

ware as much as possible, without the overhead of the operating system. This meant disabling Windows 95's EMF (enhanced metafile) spooling. The EMF architecture renders images and passes the data stream to the printer in the background, so you can continue working in the foreground. In real-world use this is advantageous, since it speeds return-to-application time, though it may sometimes add a few seconds to the total time it takes to print a file. When machines could print only with EMF spooling enabled, we noted that on the charts.

LASER PRINTERS

Minutes:seconds	Microsoft Word for Windows (5 pages)	Microsoft Excel for Windows (2 pages)	Microsoft Publisher for Windows (1 page)	Freelance Graphics for Windows (3 pages)
4-PPM ENGINE, 600-DPI RESOLUTION				
Canon LBP-465	1:33	0:56	1:12	2:32
HP LaserJet 5LXtra*	1:32	0:52	0:53	2:09
Okidata Okipage 4w	1:32	0:49	0:50	1:36
TI microLaser WIN/4	1:28	0:50	1:05	1:59
6-PPM ENGINE, 600-DPI RESOLUTION				
Brother HL-720	1:10	0:41	0:37	1:20
Brother HL-730	1:13	0:42	0:37	1:20
Lexmark Optra E	2:28	2:31	3:12	8:11
Lexmark Optra Ep (PostScript mode)	2:13	2:02	3:34	7:07
NEC SuperScript 660*	1:18	0:40	0:48	1:23
Okidata OL600e	1:30	0:48	0:38	1:30
Okidata OL610e	1:07	0:46	0:49	1:45
Panasonic KX-P6100	0:57	0:28	0:22	1:05
Panasonic KX-P6500	1:02	0:34	0:32	1:51
8-PPM ENGINE, 600-DPI RESOLUTION				
HP LaserJet 6P	0:57	0:32	0:48	1:30
HP LaserJet 6MP (PostScript mode)	1:03	0:37	1:19	3:38
NEC SuperScript 860*	0:50	0:32	0:42	1:42
Xerox DocuPrint 450B	1:34	0:46	1:32	4:38

◀ BETTER

◀ BETTER

◀ BETTER

◀ BETTER

Windows-only DeskJet 820Cse (\$486 list, \$400 street) uses your computer for print processing while producing the same high-quality output as the other 800-series DeskJets. The new DeskJet 870Cse, HP's \$599 list, \$500 street top-of-the-line personal ink jet, has the fastest speed rating; it comes with new business-oriented software and has received an Editors' Choice designation in this issue.

All of the HP color ink jets use the company's RealLife Imaging System, which includes the ColorSmart automatic color-adjusting driver. ColorSmart analyzes print jobs and determines how to

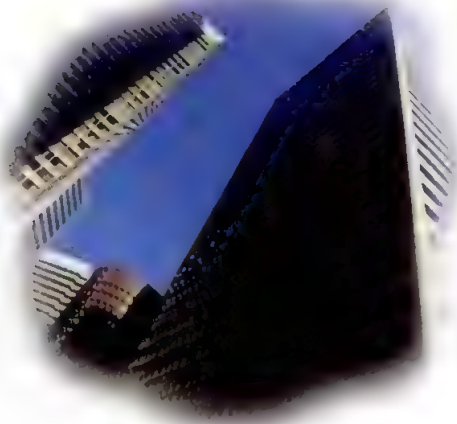
blend the colors; it then uses HP's Color-Resolution Enhancement for blending and layering color.

The three-color HP DeskJet 400 is rated at 3 ppm for black text (at 600 by 300 dpi) and 0.7 ppm for color printing (in 300-dpi mode). Its per-page cost is a low 3 cents for black but a whopping 23 cents for 15 percent color—three times as high as that of other three-color ink jets. Best used for occasional text printing, the 400 produced monochrome samples that were coarse and rough, though text samples were fuzzy only in 6-point or smaller characters. Color output was also subpar; both the photographic image and the business

chart had colors that were relatively washed out.

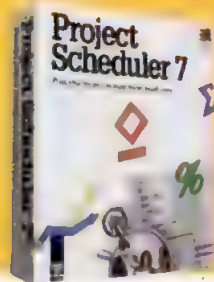
The DeskJet 682C is capable of 600-dpi resolution black printing and 600- by 300-dpi color printing. The 682C includes a fun-to-watch paper unfold, used with fanfold paper to create banners, and is a great printer for all-purpose home use. Rated at 5 ppm in black and 1.5 ppm in color printing, the 682C is relatively speedy for a home printer, as our performance tests showed.

The 682C's per-page costs are reasonable as well, at 4 cents per 5 percent black page and 11 cents for each 15 percent color page. The input tray holds 100



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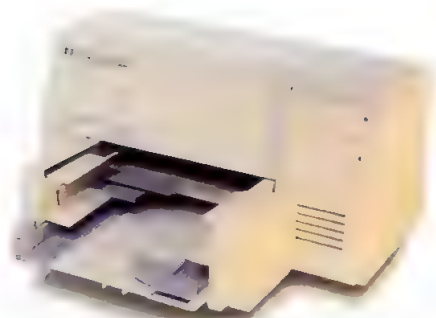
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HP DeskJet 870Cse.

sheets of paper or 20 envelopes, and as with the other 600- and 800-series printers, you can feed a single envelope even if a stack of paper is loaded in the input tray. The 682C is bundled with Disney's Mickey & Friends Print Studio for printing cards, calendars, banners, and other family-oriented output.

The 682C's text is very good, and the unit's monochrome output is noticeably smoother than the output from the 400, though some moiré patterns were visible. The color photo had good color with some visible dots. The color business graphic sample had consistent colors with moderate saturation. A good buy for home use, the 682C will be all that many families need.

For home and small-business photographic image printing, check out the new DeskJet 693C. The 693C is bundled with a new Disney package, Disney Interactive 101 Dalmatians Print Studio, which offers even more family fun. The big difference in output quality between the 682C and 693C is evident when you use the optional \$34.95 photographic ink cartridge. This cartridge replaces the

black cartridge, so when you print in photo mode you actually are doing six-color printing, using both the standard color and photographic color cartridges. Per-page cost with the special photo ink is 21 cents at 15 percent coverage. For best photo image output, you should use HP's special photo paper, which at \$11.95 (list) for 20 sheets isn't cheap but still costs much less than typical \$1-per-sheet glossy paper.

Using the photographic ink and paper with the 693C yielded noticeably better images than those from the 682C. Colors were richer, and the photos showed much greater detail. Because of the higher per-page cost, though, you'll want to use standard ink and paper for draft work and switch to the photo suppliers for final images.

The DeskJet 820Cse prints at 600 dpi in black and 600 by 300 dpi in color. A true GDI printer, it allows you to print only from Windows applications (or from a DOS box in Windows). While the 820Cse is a host-based printer that uses computer resources to process print jobs, it's fast enough that unless you are printing very large jobs or are running multiple applications, you probably won't notice much slowdown. On our performance tests the 820Cse, rated at 6.6 ppm for monochrome and 4 ppm for color, was one of the fastest ink jets overall.

Per-page costs of the 820Cse are an attractive 3 cents for 5 percent black pages and 8 cents for 15 percent color pages, prices bested only by the Epson Stylus Pro. The paper tray holds 150 sheets or 15 envelopes. In addition to 50 Professional TrueType fonts, the 820Cse is bundled with a desktop publishing package, Microsoft Publisher.

The 820Cse's quality samples were terrific, particularly its monochrome output. The gray-scale samples were smooth and clear and text quality was first-rate—hard to tell from laser print. The color photographic

image had good color but was just a bit rough, particularly in comparison with the higher-end 870Cse. The business color graphic had very rich colors but showed some streaking, and the colors weren't entirely consistent.

Aided by a 20-MHz RISC processor, the DeskJet 870Cse is the top personal ink jet in HP's line. The 870Cse is rated at an impressive 8 ppm for text printing at 300 dpi and 4 ppm in color at 600 by 300 dpi. Per-page costs are a competitive 3 cents for typical text pages and 8



From Start to Business, packaged with the HP DeskJet 870Cse, lets you design forms or use templates for leading application software.

cents for color.

The 870Cse comes bundled with HP's new From Start to Business software. This software has document templates for Word for Windows 6.0, WordPerfect 6.1, Microsoft Publisher 2.0, and Microsoft Excel on the PC side, and Word 6.0, ClarisWorks, and Excel for the Mac. You can choose or import graphics and then create memos, fax cover sheets, invoices, letterhead, business cards, envelopes, brochures, labels, sales flyers, and newsletters with the predesigned templates.

Output quality with the 870Cse is outstanding, with great text—clear and black—and high resolution and smooth gray-scale images with a lot of detail. The color photographic image sample was a big step up from the already fine 820Cse, with good color and smooth images. The color business graphic was one of the best, with good saturation, vibrant colors, and no streaking.

Hewlett-Packard's personal ink jets span the range of printing needs. The



Disney's Mickey & Friends Print Studio is bundled with the HP DeskJet 682C. With this package you select from a menu of fun home print jobs.



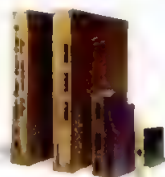
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DeskJet 400 is acceptable as a low-usage dot matrix replacement intended mostly for black text. The bargain-priced DeskJet 682C is a fun printer for home use and is now joined by the similar but slightly more upscale DeskJet 693C with optional photographic inks; the 693C is the HP to buy if you plan on printing PhotoCD or digital camera images. For business applications in Windows environments only, the speedy DeskJet 820Cse is a good bet, while the fastest as well as most personal DeskJet, the 870Cse, is hard to beat for both quality and speed.—BB

HP DeskJet 400. List price: \$248. **HP DeskJet 682C.** List price: \$370. **HP DeskJet 693C.** List price: \$431. **HP DeskJet 820Cse.** List price: \$486. **HP DeskJet 870Cse.** List price: \$599. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 208-323-2551; fax, 800-333-1917; www.hp.com. Circle 450 on reader service card.

Lexmark International Inc.

Color Jetprinter 1020, Color Jetprinter 2050, Color Jetprinter 2070

Lexmark International introduced three new personal ink jet printers this year. With its \$150 street price (\$189 list), the three-color Color Jetprinter 1020 is Lexmark's most affordable printer and is intended for entry-level users. The Color Jetprinter 2050 (replacing the soon-to-be-discontinued Lexmark WinWriter 150C) is a high-value four-color printer with a street price of \$250 (\$299 list) and 600- by 600-dpi maximum resolution in both monochrome and color. The top Lexmark personal ink jet is the Color Jetprinter 2070, which has a street price of about \$350 (\$419 list).

The Color Jetprinter 1020 is best used for minimal service applications, but the 2050 and 2070 are more suited for moderate home or small-business printing. They are costly to operate if you print a lot of color, but each of the Jetprinters is a competent output device.

All of the Lexmark Color Jetprinters are Windows-only printers (though you can print from a DOS box within Windows). The printer driver applets provide

informative status windows that accurately indicate ink cartridge levels (including individual color levels for the color cartridges). You can also pause or stop a print job from your computer.

The entry-level Jetprinter 1020 comes with a color cartridge, but you have to purchase a black cartridge separately (\$32.95) if you want a true black rather than the composite black that the color cartridge delivers. CorelDraw 4.0, a competent though somewhat dated graphics package, is also bundled with the printer.

You must feed envelopes singly, and there is no output tray, so unless you keep the printer back from the edge of your table or desk, pages will spill onto the floor. Cost per printed page is 3 cents with the black cartridge at 5 percent coverage, which is on a par with other low-cost ink jets. Color pages (with 15 percent coverage) will cost you 17 cents a page—among the highest rate in this roundup for non-specialty ink.

On our application tests, the 1020 was about as fast as the other three-color printers overall. Quality samples produced even, black text. Gray-scale printing had no visible banding but was fairly coarse. Color printing isn't this unit's strong point: The color photographic images had banding and broken color lines, while the business graphics printed out with pale and somewhat inconsistent colors that showed visible banding.

The Color Jetprinter 2050 is the company's newest model, a dual-head, four-color printer rated at 4 ppm for black and .5 ppm for color. The 2050's per-page costs are the same as the 1020's, and it uses the same cartridges as the three-color printer.

Among the 2050's advantages over the 1020 are a 150-sheet (or 15-envelope) input tray capacity and an output tray that has an extension to hold legal-size sheets. The software bundled with the 2050 is a new package called Lexmark Workshop CD-ROM. The CD contains such home user software as Monotype's GreetingCardMaker, CertificateMaker, and T-ShirtDesignMaker, as



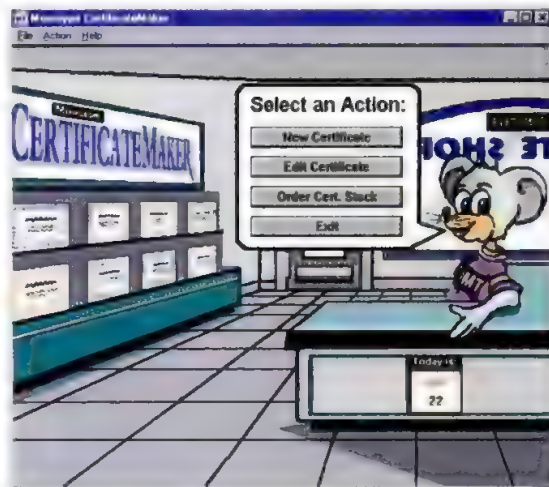
Lexmark Color Jetprinter 2070.

well as SoftKey's Labels Unlimited and Comic Creator. SoftKey's EarthLink Network TotalAccess, an Internet package with photo manipulation capabilities, is also on the CD.

The 2050's output quality is a clear step up from that of the 1020, with good resolution and smooth images in monochrome gray-scale printing and fine text. The photographic sample colors were somewhat bland, but the images were smooth. The color business graphic sample had richer colors than the 1020 but was still pale for the group and showed some visible banding.

The 2050's speed test performance was about average in 300-dpi mode but much slower than average for the group in 600-dpi printing, with the Microsoft Word test taking almost ten times as long as at the lower resolution.

The Lexmark Color Jetprinter 2070 is the company's fastest printer, rated at 5 ppm for letter-quality text and 1 ppm for color. The 2070 was easily the fastest print-



Bundled with the Lexmark Color Jetprinter 2050, the Lexmark Workshop CD-ROM includes several applications, including Monotype's CertificateMaker.

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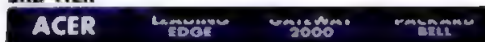
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Source: PC World Reliability & Service Monitor, May 20 - November 20, 1995



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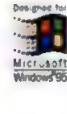
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- Family Pak includes: ABC by Dr. Seuss; Thinkin'
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- Microsoft Home Pak includes: Works 4.0 for
Windows 95; Publisher Deluxe for Windows
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Central 96; Wine Guide; Arcade 1.0; Scenes—
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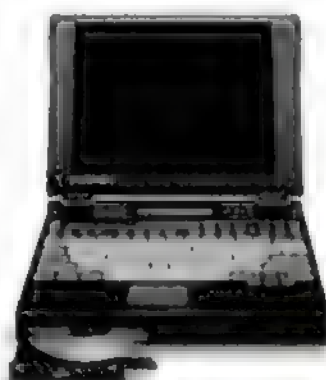
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er in the group on our Microsoft Word and Publisher tests, both in monochrome and in color modes. Cost per page is a low 3 cents for black but a high 20 cents for color. The 2070 comes bundled with CorelDraw 4.0.

Output samples showed particularly black, clear text at high resolution but not particularly smooth gray-scale graphics. The color photographic output was good, with deep colors. The color business graphic, while producing the richest colors of the Lexmark printers, still had some banding and streaking.

Three reasonable choices, the Lexmark Color Jetprinters are a little more costly per page as a group for color printing but otherwise they represent good values.

Color Jetprinter 1020. List price: \$189. **Color Jetprinter 2050.** List price: \$299. **Color Jetprinter 2070.** List price: \$419. Lexmark International Inc., Lexington, KY; 800-358-5835, 606-232-2000; fax, 606-232-2873; www.lexmark.com. *Circle 451 on reader service card.*

LASER PRINTERS

Brother International Corp.

Brother HL-720, Brother HL-730



The Brother HL-720 and HL-730 laser printers are well-designed for the small-business or home user who, though budget-conscious, still wants good 600-dpi output and 6-ppm performance.

At \$350 street, the HL-720 carries one of the lowest prices for lasers in this roundup, below even that of some 4-ppm models. But note that it's a GDI-only printer (no PCL emulation at all), to be used only with Windows applications.

At \$400 (street), the physically identical Brother HL-730 adds PCL 5e support and other printer emulations. Given the choice, we would pony up the extra \$50 and buy the HL-730—an Editors' Choice in this roundup. Other laser printers are more adept at producing photo images and graphics, but for text-intensive uses these Brothers are fine.

Both printers come with 512K of RAM (expandable to 1.5MB) and

Brother's memory-compression technology. The starter toner cartridge is good for 1,000 sheets, and Brother's two-part toner/drum setup keeps the cost of consumables down. The standard replacement cartridge (\$33.99) is rated at 2,200 pages; a new imaging drum (rated at 20,000 pages) runs \$192.99. Reported cost per page for each is 2.5 cents for 5 percent toner coverage—average for the group.

Setting up either unit is as easy as plugging it in, attaching the cable, and loading the driver disk. Brother's Surf and Print utility gives you the ability to print Web pages that you've captured from the Internet.

The print quality is fine for printers in this price range. Fonts on our sample prints were dark, clean, and clear, even at low point sizes. Gray-scale images from the HL-720 had both good definition and contrast. We did notice a slight reduction in the darker end of the gray-scale range—what should have been 90 percent gray looked almost black—and there was occasional banding in dark areas on both solid and gradient fills. Halftone images and graphics produced on the HL-730 were a bit less pleasing than those of its sibling, and photographs were a bit heavy on contrast. The HL-730 showed some banding and an inability to produce 90 percent gray.

Both printers performed well on our speed tests, placing average or a little above among tested 6-ppm units on most of our tests, even for complex documents. Paper handling was very good, and the printers' straight paper paths reduce the risk of jams. When we forced a jam the HL-720's driver informed us of the problem, and once we cleared it the printer produced the entire job, replac-



Brother HL-730.

ing the damaged page with a second copy. Transparencies came through perfectly, but envelopes showed some crinkling at the fold.

The Brother HL-720 and HL-730 are easy to operate and inexpensive to use, and they offer solid performance at an attractive price. They are not well suited to graphics-intensive applications, but for typical business or personal printing they should be on your short list.—*James Karney*

Brother HL-720. Street price \$350. **Brother HL-730.** Street price: \$400. Brother International Corp., Somerset, NJ; 800-276-7746, 908-356-8880; www.brother.com. *Circle 447 on reader service card.*

Canon Computer Systems Inc.

Canon LBP-465

The Canon LBP-465 exemplifies the newest trends in personal laser printers—some of which are advantages, and some of which are not. With a street price of \$350 (\$379 list), this 4-ppm-rated printer is priced right for its targeted small or home-office markets, and its inclusion of Microsoft Windows Printing System makes it easy to use. Its small size makes it easy to fit in cramped quarters, but all of these features have some drawbacks that you should consider.

This printer is for Windows 95 alone; no other operating environments need apply. It is a GDI device that relies on the computer's CPU to do all the heavy lifting of page formatting. The printer does have PCL 4 support, but only for applications running in a DOS window. It has a nearly straight paper path but delivers output face-up, pushing it unceremoniously onto the table top. The result is an untidy pile of pages that you have to hand-collate into proper order. We're all for cutting costs, but some sort of output tray would seem to be a worthwhile addition. The printer also lacks a separate manual feed slot: To print an envelope, you have to remove the stack of paper and adjust the feed-slot guides.

The LBP-465 is completely Plug and Play-compatible, and we experienced no installation hitches. The driver detects error conditions and instructs you (using text and graphics) on how to resolve them, though you need to have the status

SUMMARY OF FEATURES

Personal Lasers

■ YES ■ NO □ OPTIONAL

Products listed in alphabetical order

PC MAGAZINE
EDITOR'S CHOICE

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	Brother HL-720	Brother HL-730	Canon LBP-465	HP LaserJet 5LXtra	HP LaserJet 6P	HP LaserJet 6MP	Lexmark Optra E
List price/Street price	\$449, \$350	\$499, \$400	N/A, \$380	\$589, \$480	\$939, \$800	\$1,139, \$950	\$639, \$500
Standard/maximum RAM	512K, 2MB	512K, 2MB	256K, 256K	1MB, 9MB	2MB, 50MB	3MB, 35MB	1MB, 5MB
Memory-compression technology	■	■	■	■	■	■	■
Dimensions (HWD), in inches	9.8 x 14.4 x 13.9	9.8 x 14.4 x 13.9	9.8 x 13.2 x 12.6	13.2 x 12.3 x 8.9	7.9 x 15.0 x 17.5	7.9 x 15.0 x 17.5	8.6 x 13.7 x 8.7
Rated speed (pages per minute)	6	6	4	4	8	8	6
Maximum engine resolution (dots per inch)	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600
Maximum interpolated engine resolution (dots per inch)	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600	600 x 600
Paper Handling and Interface							
Capacity of each standard input cassette or tray (number of pages)	200	200	100	100	250	250	150
Prints on legal-size paper	■	■	■	■	■	■	■
Prints on envelopes/card stock	■	■	■	■	■	■	■
Parallel/serial port	■	■	■	■	■	■	■
Bidirectional/ECP parallel support	■	■	■	■	■	■	■
C-size parallel port/LocalTalk port/rDA port	■	■	■	■	■	■	■
Features							
Resolution enhancement	■	■	■	■	■	■	■
HP PCL/Adobe PostScript support included	None/None	None/None	PCL 4/None	PCL 5/None	PCL 6/None	PCL 6/Level 2	PCL 5a/None
Supports Adobe PrintGear	■	■	■	■	■	■	■
Host-based printer	■	■	■	■	■	■	■
RAM/hard disk space required on PC	4MB, 10MB	N/A	8MB, 7MB	N/A	N/A	N/A	N/A
Other printer emulations supported	None	Epson FX-850, IBM ProPrinter	MSW printing system	None	None	None	PPDS
Printer-specific Windows 3.x/Windows 95 drivers	■	■	■	■	■	■	■
Printer-specific Windows NT, OS/2 Warp drivers	■	■	■	■	■	■	■
Driver applet allows watermarks/booklets/thumbnails	■	■	■	■	■	■	■
Driver applet allows manual duplexing/fit-to-page/poster printing	■	■	■	■	■	■	■
Consumables and Customer Support							
Toner or cartridge capacity (pages)	2,200	2,200	2,500	2,500	4,000	4,000	3,000
Rated duty cycle (pages per month)	3,000	3,000	5,000	4,000	12,000	12,000	10,000
Rated cost per page of double-spaced text	2.5 cents	2.5 cents	3 cents	2 cents	2 cents	2 cents	2.5 cents
Toll-free technical support	■	■	■	■	■	■	■
Technical-support hours (eastern time)	6:00-5:00 M-F	6:00-5:00 M-F	6:00 A.M.-midnight M-F	8:00 A.M.-midnight M-F; 11:00-6:00 Sat., Sun.	8:00 A.M.-midnight M-F; 11:00-6:00 Sat., Sun.	8:00 A.M.-midnight M-F; 11:00-6:00 Sat., Sun.	10:00-7:00 M-F
Warranty (parts and labor)	1 year	1 year	3 years	1 year	1 year	1 year	1 year
Overnight exchange for warranty service	■	■	■	■	■	■	■

N/A—Not applicable. The product does not have this feature.

monitor utility running on your computer in order to receive the warnings. The printer also comes with a CD-ROM of goodies that includes 300 TrueType fonts, a collection of 300 clip-art images, and a



Canon LBP-465.

searchable database of 2,000 quotations.

Canon's laser engine produces excellent output. Areas of black are solid and smooth, and the 600-dpi resolution (plus enhancement) makes even tiny text smooth and legible. There was some faint horizontal banding in large areas of gray, and the diffused dither pattern for halftone images produced output that was too dark with too much contrast. Aside from these small flaws, the output was among the best and is well suited for business applications. On our speed tests, the printer was on a par with other 4-ppm machines.

Canon offers a three-year warranty with overnight exchange, which is longer than most warranties and should provide

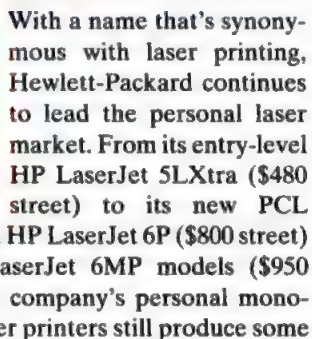
some security for SOHO users who might not have another printer to use when one breaks down. For weekend workers, Canon's 18-hour-a-day, seven-day-a-week toll-free technical support is also a welcome security blanket.

The LBP-465 does the job it sets out to do. It is hampered a bit by its limited paper handling and an awkward output arrangement, but the rest of its features make it an attractive printer that comes at an affordable price.—AP

Canon LBP-465. List price: \$379. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; fax, 408-945-1135; www.ccsi.canon.com. *Circle 448 on reader service card.*

PC MAGAZINE
- - - - -
EDITORS' OFFICE

**HP LaserJet 5LXtra,
HP LaserJet 6P,
HP LaserJet 6MP**



The 600-dpi output from all three printers was top-notch—noticeably better than output from other lasers. Text is solid and fully saturated without fuzzy edges, and graphics are crisp and smooth without the loss of detail seen in the output of printers from some other vendors. The LaserJet 5LXtra's output is nearly as clean and reliable as that of its more expensive siblings.

professionals, the LaserJet 5LXtra comes with features that will appeal to those who have varied but low-volume print needs. The 600-dpi, 4-ppm printer comes with PCL 5e compatibility and loads of software, including Netscape Navigator Personal Edition, 70 True-Type fonts, HP's own PIM, and Family Health Tracker.

The Plug and Play drivers enable you to set up the printer for either host-based or client-based printing. You can also turn resolution enhancement on or off, adjust toner density, brightness, contrast, and printer resolution (300 or 600 dpi), and switch on EconoMode for toner-saving draft printing. The printer's vertical-

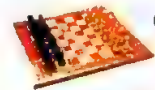


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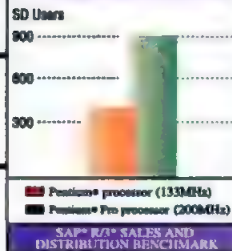
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Guide to Laser Output

The new standard resolution for personal laser printers is 600-by-600 dpi, and many offer 1,200-dpi output through interpolation. Text quality was nearly identical across the board; graphics quality varied.

These samples were produced at each printer's default resolution using the medium-grade paper recommended for laser printers. Text output varied almost not at all; edges were unfailingly crisp, although the 300-dpi output of the Panasonic KX-P6100 is noticeably less exact than 600-dpi samples. The photo graphic separated the outstanding from the merely good.

The best printers here in terms of output quality—the HP LaserJet 5LXtra, HP LaserJet 6MP, and HP LaserJet 6P—showed excellent tonal range in the photo, with much less of a “dotty” effect. Some of the printers went to black too quickly, obliterating details in the shadow area.

The Brother HL-720 and HL-730, for example, could not reproduce dark grays well, which is visible in the photo and on the gray-scale step chart below. The Canon LBP-465, meanwhile, produced gray-scale output that was a little heavy on contrast.

Output quality from the Lexmark Optra E and Ep rivaled the HPs'; our samples show proper contrast and smooth tones. The Okidata printers, though printing at only 300 dpi, use a smoothing algorithm that makes text almost indistinguishable from true 600-dpi output.

LASER PRINTER SAMPLES

The photo should show good tonal range, without fading too quickly to black in the shadow areas

The various shades of gray in this step chart should differ noticeably, and the final box should be gray, not black.

Text should have sharp edges and crisp curves. The word *Labs* is shown in its actual size and enlarged four times.

Line edges should be straight, not jagged. Better printers resolve individual lines almost to the center circle.



Brother HL-720, 600-dpi



Brother HL-730, 600 dpi



Canon LBP-465, 600 dpi



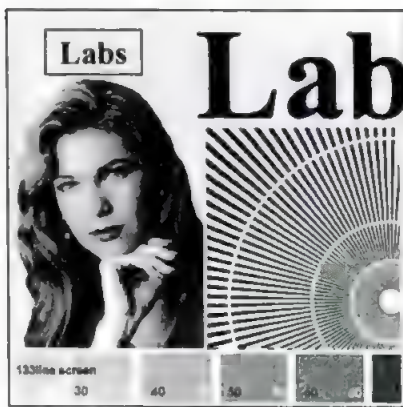
HP LaserJet 5LXtra, 600 dpi



HP LaserJet 6MP, 600 dpi



HP LaserJet 6P, 800 dpi



Lexmark Optra E, 600 dpi



Lexmark Optra Ep, 600 dpi



NEC SuperScript 660, 600 dpi



NEC SuperScript 860, 600 dpi



Okidata Okipage 4w, 300 dpi



Okidata OL600e, 600 dpi



Okidata OL610e, 600 dpi



Panasonic KX-P6100, 300 dpi



Panasonic KX-P6500, 600 dpi



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HP LaserJet 6P.

stacking sheet feeder can handle a variety of paper sizes (A 4, letter, legal, executive, and 3- by 5-inch postcard), and a separate feeder lets you bypass the bin to print a single item (such as an envelope, letterhead, or transparency) without removing the letter paper. There's no LCD printer status display panel or even a power switch on the 5L: It simply goes into sleep mode after 15 minutes of inactivity. Print speed is on a par with that of other 4-ppm printers.

With their 8-ppm engines and more robust paper-handling options, the LaserJet 6P and 6MP are intended for SOHO and mainstream business users. Both models boast such niceties as infrared serial ports, small and large parallel ports, LocalTalk ports for Macintosh machines, and 250-sheet bottom bin feeders. A flip-down front paper tray can handle an additional 100 sheets, single sheets (if you want to feed in transparencies or letterhead), or up to 10 envelopes.

The extra \$150 for the 6MP gets you 3MB of memory (versus the 6P's 2MB) and genuine Adobe PostScript support. Both LaserJets boast the next-generation printer language from HP, PCL 6. Dubbed "enhanced" in the printer driver options, PCL 6 mode is intended to deliver better printing performance with complex graphics and improved WYSIWYG under Windows.

Setting up and installing the Plug and Play machines was simple, though a full installation of the printers' drivers requires over 13MB of disk space. Included is a ToolBox utility that lets you set print options and informs you of the printer's status. The full-featured driver has an easy-to-use interface that lets you create booklets, thumbnails, custom watermarks, and more.

On typical business printing tasks, the 6P was one of the fastest models at print-

ing out text and spreadsheets in its default 600-dpi, PCL 5e mode. Though it didn't show the same alacrity in handling graphics print jobs, it still returned respectable results. The 6MP was one of the slower performers in its class, mainly because its default print mode (which we used for testing) is PostScript, which is generally slower than the PCL mode but is better for graphics-intensive work. On our samples, the PCL 6 mode of the LaserJet 6MP produced printouts that were virtually identical in terms of image quality to those it produced in PostScript mode.

Any of these LaserJets is a good bet. For personal printing needs at home or in an office where there is a network printer to handle tougher jobs, the 5LXtra can't be beat. If you need a business printer that will be your primary output device, consider the 6P or 6MP.—*JRQ*

HP LaserJet 5LXtra. List price: \$589. **HP LaserJet 6P.** List price: \$949. **HP LaserJet 6MP.** List price: \$1,119. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 208-323-2551; www.hp.com. Circle 450 on reader service card.

Lexmark International Inc.

Lexmark Optra E, Optra Ep

The Lexmark Optra E (\$639 list, \$500 street) and Optra Ep (\$949 list, \$750 street) are 6-ppm, 600-dpi lasers targeted squarely at small businesses and corporate business users rather than the home or SOHO audiences that lower-priced units are generally intended for. Though neither is a performance standout, both offer excellent output, topflight management software, a small footprint, and the ability to work with virtually any operating system.

The extra \$250 for the Optra Ep gets you Lexmark's own PostScript Level 2 emulation (PCL 5e is standard on both) and 2MB of RAM standard (versus 1MB for the Optra E). Both Optras come with the fine MarkVision management software and deliver above-average paper-handling capability for this segment of the market, including the ability to print on labels and index card stock. An optional 250-sheet input bin (\$199) supplements the standard 150-sheet tray. Other op-



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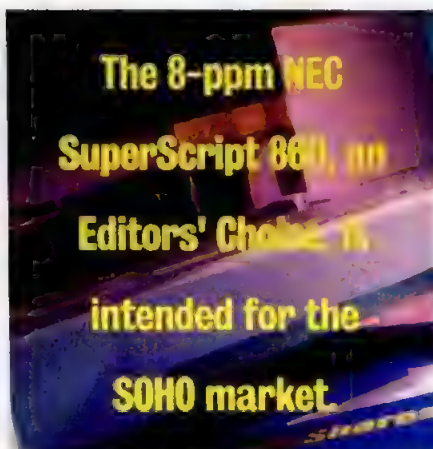
tions include a network card, flash memory, and an RS232C/RS422 serial port. The Optras have a rated duty cycle of 10,000 sheets per month, among the highest in this roundup.

Setting up the Optras is a simple exercise. Slide the toner and photoelectric drum into their slots, plug in the unit, add paper, and load the drivers. While you can use Lexmark's basic Windows driver to communicate with the printer, its Mark-Vision remote-control software is outstanding and well worth the little bit of extra disk space it requires. Its easy-to-use interface lets you control all printer functions, set options (including fine-tuning for graphics), and track status. There is virtually no need to go to the printer or refer to its LED panel except to retrieve finished jobs, clear jams, or add more paper. The Optra recovered perfectly from a forced jam and reprinted the jammed page automatically. The two-part toner/drum setup helps reduce toner replacement costs.

Output quality is outstanding. Text was clear and clean. Fills and graphics printed smoothly without banding. The image enhancement technology and PQET font smoothing produced notable improvement at 300 dpi. Halftone images printed with good contrast and smooth tones.

On our print speed tests, the Optra units were less impressive. The pair finished last on virtually every task, needing a minute or even several minutes more than other 6-ppm printers to produce our documents. We found that the Optras did not compress files as much as their competitors (such as the HP LaserJet 6P) did, which could account for the time lag.

The Optras won't win any prizes for speed, but they do offer solid construc-



tion, network capability, outstanding management software, and clear, clean output. Their paper handling and management tools may make them a favorite for users who value ease of operation and maintenance over rapid output.—JK
Lexmark Optra E. List price: \$639. **Lexmark Optra Ep.** List price: \$949. Lexmark International Inc., Lexington, KY; 800-891-0331, 606-232-2000; fax, 606-232-2873; www.lexmark.com. Circle 451 on reader service card.

NEC Technologies Inc.

NEC SuperScript 660, NEC SuperScript 860

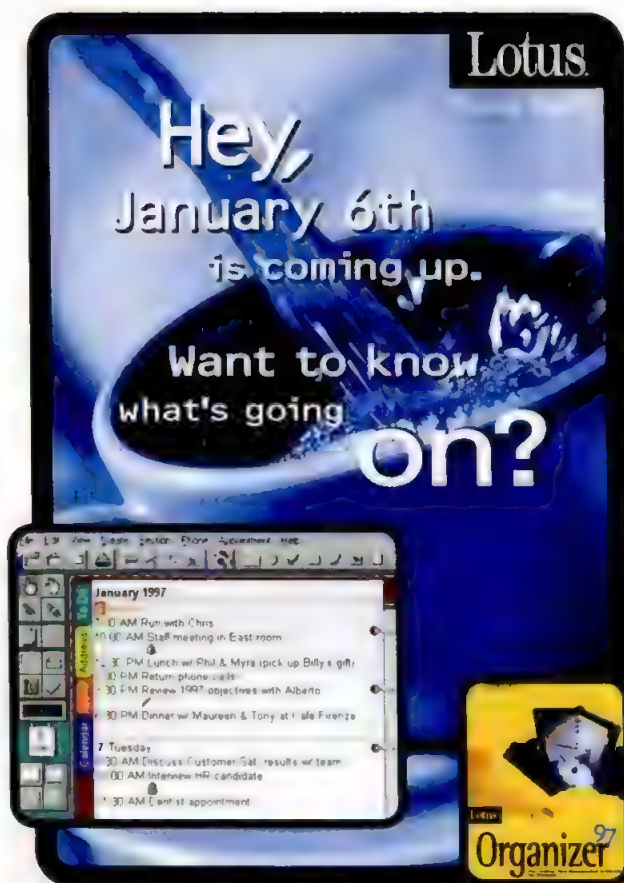


Although these two SuperScripts look similar on the outside, the 660 and 860 are quite different inside. The 6-ppm 660 (\$400 street, \$300 after rebate, through January 1997) is a Windows-only printer targeted at the entry-level user who needs quality black-and-white printing at a low cost. The 8-ppm 860 (\$500 street, \$450 after rebate), an Editors' Choice, is intended for the more demanding SOHO market, where its flexible output and faster performance gives it an edge. While both printers have some limitations, they are well suited for their respective missions.

Setup is easy, and both SuperScripts are Plug and Play-compliant. Both have similar engines but exhibit some small differences in paper handling. Both have input bins, and both have a face-up output bin with a fold-out face-down tray



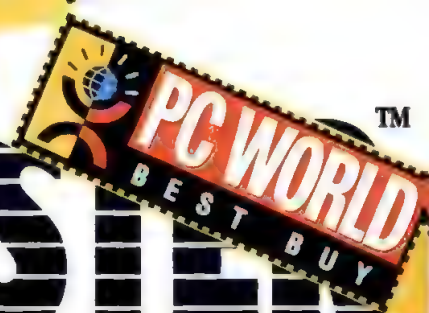
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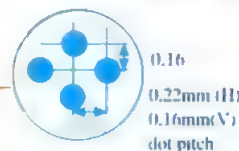
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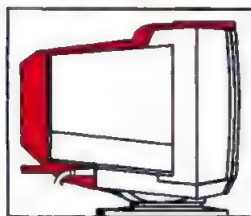
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NEC SuperScript 860.

that provides a nearly straight paper path. The 860 has a separate manual tray that you have to pull open to use, then push back in place so that paper can feed from the input bin. This is not as convenient as a "full-time" manual feed slot. We also encountered some paper jams when trying to make two-sided prints using the manual feed.

With enhanced 600-dpi output, both printers produced good-quality text, even in tiny 6-point type. The SuperScript 860 did a slightly better job on our test photo image, but both produced sharp, solid blacks on other graphics. The only noticeable flaw in output quality was some vertical and horizontal banding on large areas of gray. Both printers would do well on typical business print jobs.

The 660 uses the Destiny WinStyler driver and the host computer's CPU for page processing. Remarkably, PCL 5e emulation is supported for printing from a DOS box in Windows; most other GDI printers provide only PCL 4 support. The 660 comes with a starter cartridge rated for 2,000 pages; one-piece toner/drum replacements (\$115) are rated at 4,000 sheets. NEC also offers blue, red, and yellow toner cartridges for the printer (\$159 each). Print speeds were on a par with most of the other 6-ppm printers in this roundup.

The 860 is more self-reliant than the 660 in the brains department, with its own 50-MHz Adobe PrintGear processor. PrintGear is a new PDL (printer description language) developed by Adobe as an alternative to PCL and PostScript. Adobe says that PrintGear is optimized for the types of mixed text-and-graphics print jobs SOHO users are likely to need, and our tests supported this claim. The SuperScript 860 beat its 8-ppm competitors on three of our four print speed tests.

The 860's driver applet also eclipses most in this roundup, with sophisticated

features including watermarks, thumbnail layouts (multiple page images per page), manual duplexing, and booklet printing. The 860 comes with a Solutions CD that includes 78 fonts, Adobe Type Manager, the Adobe Acrobat Reader, and a clip-art collection. The CD also has a printing guide, "How to Look Good on Paper," and a complete Internet in a Box software kit including Spry Mosaic 2.0.

The printers are both backed by a two-year warranty with overnight replacement, one of the best policies of the bunch. Technical support is more limited and is not geared to the extended hours of the SOHO and home markets.

Each of these printers has some features that could be improved, but when you balance the low cost against the good performance and quality output, they represent two of the best bargains in the group.—AP

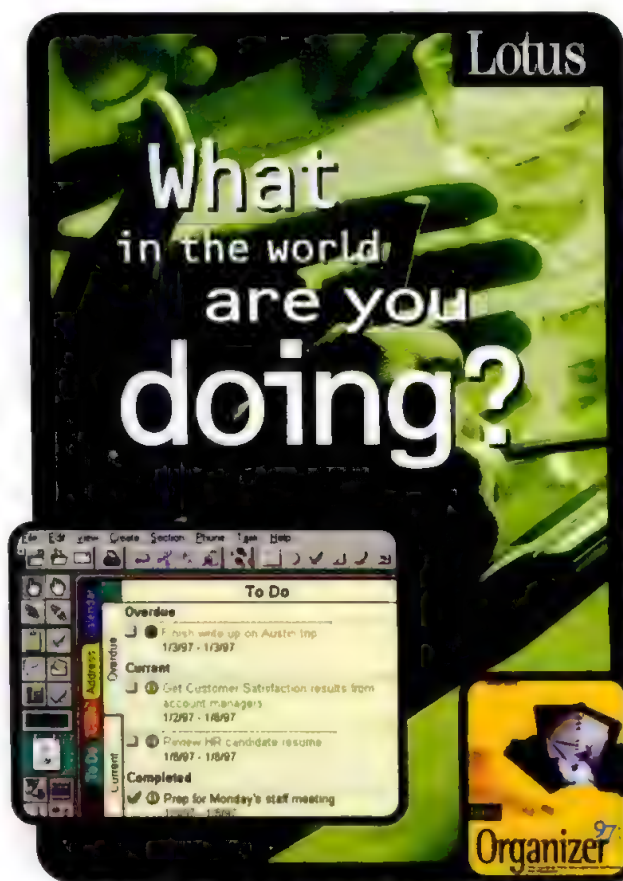
NEC SuperScript 660. Street price: \$400. **NEC SuperScript 860.** Street price: \$500. NEC Technologies Inc., Mountain View, CA; 800-632-4636, 415-528-6000; www.nec.com. Circle 452 on reader service card.

Okidata

Okidata Okipage 4w, Okidata OL600e, Okidata OL610e

Peas in a pod: You can't tell the 6-ppm Okidata OL600e (\$499 list, \$400 street) and Okidata OL610e (\$679 list, \$500 street) apart until you get close enough to read their nameplates. Both deliver PCL support and are targeted at the SOHO market, though the OL610e is designed to be more flexible to handle the wider range of print jobs that might be required in a small to medium-size office. The lilliputian Okidata Okipage 4w (\$399 list, \$300 street) could be mistaken for a toaster oven: It's the smallest laser printer in this review and also one of the least expensive. Rated at 4 ppm, this Windows-only printer is intended for home PC users or students who want an easy-to-use output device that does not take up much room. All three are solid, recommendable efforts.

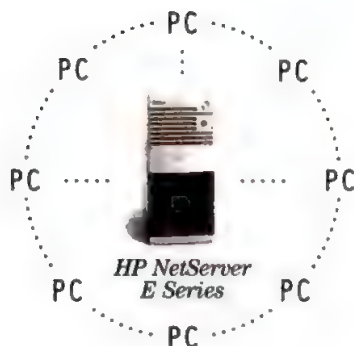
These Okidata units use a 300-dpi



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Okidata OL610e.

LED array instead of a laser to create page images. Unlike some of the low-cost lasers in this roundup, all three Okidata printers have both an input tray and a manual feed slot; the latter makes it easier to print one-off items such as envelopes. The Okipage 4w delivers its output face up, which means you'll have to collate jobs by hand.

The OL600e and OL610e have traditional face-down output bins. One limitation that both units share is that Okidata recommends against printing on both sides of the page; doing so can transfer toner to the backup roller, which in turn can cause smudges on the backs of pages.

All three printers use a two-piece toner-and-drum setup to save you money on consumables. The toner charge (\$28.50) for the Okipage 4w is rated for 1,000 pages, and the toner for the other two (\$32) is rated at 2,000 pages, which makes cost per page a competitive 2.5 cents for text.

The printers were recognized by the Windows 95 Plug and Play feature, and installation for the OL600e and OL610e went smoothly. The Okipage 4w installation had some glitches; the most notable problem was that Windows 95 kept recognizing the printer as new hardware each time we rebooted—and repeated the installation. A call to Okidata technical support verified that this was a known bug in the installation routine, and the solution was to cancel out of the installation when it started the second time. The Okipage 4w is a GDI printer and requires either Windows 3.x or Windows 95, though PCL 4.5 compatibility is provided for applications running in a DOS box.

Okidata printers have long had a reputation for producing solid and dark black areas, and these three units hold true to

the tradition. Despite the fact that they can address only 300 dpi, these printers have a mode in which they can position the dots in any of four positions—which is almost the same as providing 600-by-300 resolution. With the smoothing enabled, even small text looks almost indistinguishable from true 600-dpi output. The OL600e and OL610e have a little more flexibility than the Okipage 4w, with three dither patterns available to produce halftone gray-scale images. The only noticeable flaw in the trio's output was some vertical and horizontal banding.

On our speed tests, the Okipage 4w and OL610e yielded average performance overall, on a par with like units. The OL600e generally trailed the 6-ppm competition, turning in times that more closely matched its 4-ppm stablemate.

Okidata provides a five-year warranty on the LED print mechanism and a one-year limited warranty on the rest of the printer. The warranty on the Okipage 4w includes overnight replacement. The ease of use, overnight replacement warranty, and low price make the

Okipage 4w attractive, if a GDI printer suits your needs. The OL610e has a small speed advantage, but it is not clear that the extra speed justifies the extra cost. Of the three models, the OL600e may be the best bargain, with its middle price and good output.—AP

Okidata Okipage 4w. List price, \$399. **Okidata OL600e.** List price, \$499. **Okidata OL610e.** List price, \$679. Okidata, Mt. Laurel, NJ; 800-654-3282, 609-235-2600; fax, 609-222-5320; www.okidata.com. Circle 453 on reader service card.

Panasonic Computer Peripheral Co.

Panasonic KX-P6100, Panasonic KX-P6500

The name of the game in the SOHO and home laser markets is space: How much of this precious commodity does your printer need? Panasonic must have taken its inspiration from Manhattan or Tokyo for its 6-ppm Panasonic KX-P6100 and KX-P6500, because these units save space by going up. The tower PC-like design requires just a 5-inch by

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Personal Printers

15-inch footprint, plus 6 inches for the flip-down paper trays.

The KX-P6100 (\$499 list, \$400 street) is a Windows-only 300-dpi GDI printer, while the KX-P6500 (\$549 list, \$450 street) ups the ante with 600-dpi output and DOS support. Both are targeted squarely at the SOHO market, and the networking options for the KX-P6500 also make it suited for medium-size offices as well.

The KX-P6100 includes a PCL 4.5 emulation mode for DOS applications running in a DOS window. The PCL 4-compatible KX-P6500 can print directly from DOS without Windows. Both have the same paper-handling features, which are limited to a single multi-purpose input bin (100-sheet capacity) and a 50-sheet face-down output tray. The lack of a separate manual feed slot makes envelope printing less convenient, because you have to remove any paper in the input tray first.

Both printers installed quickly and easily, thanks to Windows 95's Plug and Play ability. A Windows Console utility makes it easy to configure the printers and monitor their status. Error conditions are reported with text and an animated graphic showing how to resolve them. The Windows driver is based on the Destiny WinStyler driver, which includes some handy features such as 2- and 4-up layouts and page image scaling. The drivers also include a Photo Enhancement Technology feature but do not offer different dithering patterns. The printers have separate toner and drum consumables, and each \$30 to \$35 toner charge is rated for 2,000 pages.

Both printers use enhanced resolution technology to smooth the edges of text and line art. The difference between the 300-dpi KX-P6100 and the 600-dpi KX-P6500 was quite noticeable, even on text as large as 10-point. Both printers were able to produce sharp areas of black, but large gray areas did have some faint horizontal banding. Both printers would serve well for most business documents, but to produce desktop publishing originals for duplication, the extra resolution of the

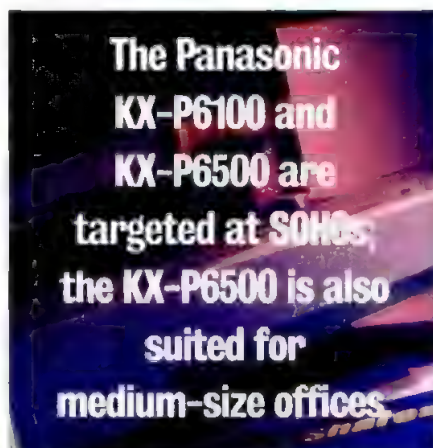


Panasonic KX-P6500.

KX-P6500 is worth the extra cost.

If it's raw speed that you want, however, consider the KX-P6100. Thanks to its lower resolution, this unit consistently turned in some of the fastest times on our print speed tests. The KX-P6500 was also nearly as fast, and when you consider it had to

cope with four times as much data (at 600 dpi instead of 300 dpi), it stands out as one of the faster performers in the bunch. The only place where the KX-P6500 was significantly slower than its lower-resolution sibling was on the Freelance



Graphics test, but it was still faster than many competing printers.

These printers from Panasonic have speed and good print quality. Their attractive features are offset by limited paper handling, but the space-saving design might be worth the tradeoff. —*AP*
Panasonic KX-P6100. List price: \$499. **Panasonic KX-P6500.** List price: \$549. Panasonic Computer Peripheral Co., Secaucus, NJ; 800-742-8086, 201-348-7000; www.panasonic.com. Circle 454 on reader service card.

Texas Instruments/Genicom Corp.
TI microLaser Win/4

Home and office Windows users in search of an inexpensive laser printer can stop right here. At \$330 (street price), the 4-ppm, 600-dpi TI microLaser Win/4 is one of the most inexpensive laser printers in this roundup. It's also a more than reasonable per-

former, easy to set up, and not much bigger than a toaster.

In fact, the only uncertainty concerning this model is its future: Genicom Corp., a maker of production-level impact and ink jet printers, has agreed to purchase Texas Instruments' printer business, and the company has indicated that personal lasers do not fit with the rest of its product line. So the fine little microLaser may be a lame duck. Genicom will keep the printer on the market until supplies run out, sometime in 1997, and provide technical support. TI will continue to offer toner cartridges for seven years.

Designed for Windows users, the microLaser Win/4 is a host-based GDI printer that uses the Windows Printing System. It relies on your computer to do the work and requires only 512K of its own memory. Control software lets you print out halftones with smooth, patterned, or solid shading. You can adjust overall print quality using 300-dpi or 600-dpi settings and by adjusting brightness and contrast slider controls.

You can also change the size and source of paper via software controls. The standard paper bin holds 100 sheets and feeds them to the face-down (meaning properly collated) output tray; there is also a straight-through path for envelopes, transparencies, and card stock. A wall poster guides you through installation. Our microLaser refused to print properly on our test system using a bidirectional EPP port; switching it to a bidirectional ECP resolved the conflict.

On our business printing tests, the microLaser was quick, turning out sheets faster than some 6-ppm printers. Graph-



TI microLaser Win/4.

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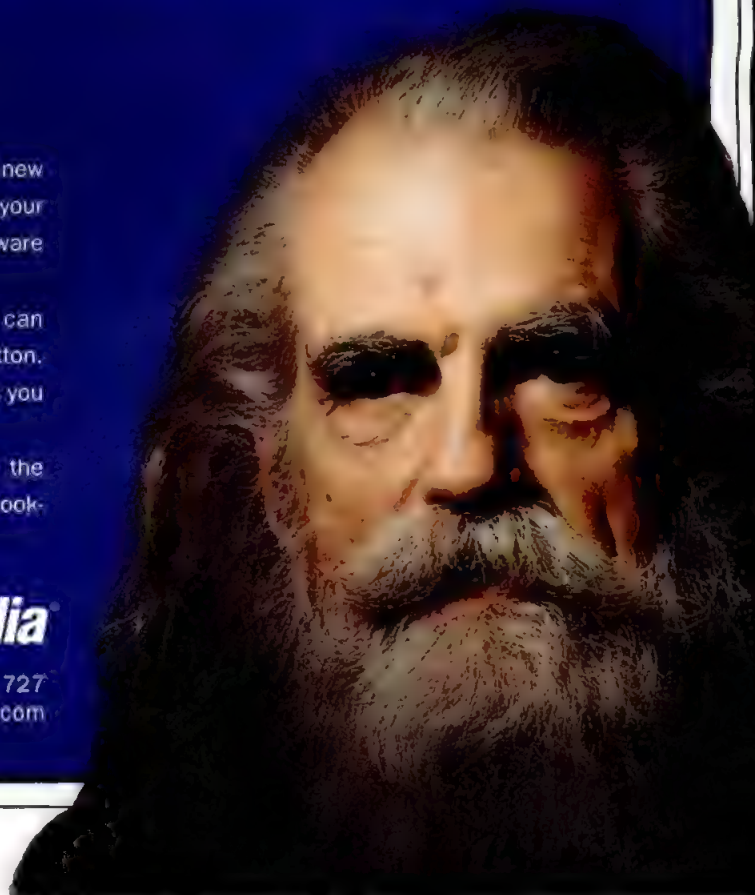
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ics-intensive layouts and presentation slides printed more slowly, but times were on a par with those of other 4-ppm machines. Text quality was solid, with saturated blacks and fonts as small as 6 points clearly readable. Graphics print quality was respectable, although there was a subtle crosshatch effect in some black-and-white halftones.

If you're a Windows user shopping for a quick, inexpensive laser printer, this may be the model you're looking for. And with Genicom clearing out inventory, you may be able to score a bargain.—*JRQ*

Ti microlaser Win/4. Street price: \$330. Genicom Corp., Chantilly, VA; 800-436-4266; fax, 540-949-1392; www.genicom.com. Circle 455 on reader service card.

Xerox Corp.

Xerox DocuPrint 4508

With a sturdy design, tight footprint, and solid 8-ppm, 600-dpi print engine, the Xerox DocuPrint 4508 (\$799.99 list, \$700 street) is aimed at business users looking for a no-nonsense laser printer for moderate to heavy-duty personal printing. The DocuPrint delivers clear text and gray-scale images and costs about \$100 less than leading 8-ppm models like the HP LaserJet 6P, though some software quirks marred our testing experience.

Setting up the DocuPrint hardware couldn't be easier. It uses a single toner cartridge and is Windows 95 Plug and Play-compatible. The accompanying software—including a font manager, remote-control utility, and status applet—gives users a fair amount of printing control, allowing you to change such settings as dithering level, overall print quality, and

halftone intensity for photographic images; the unit can also run in economy mode to save toner.

Software installation isn't as straightforward as it should be, however. Initially, some documents printed as quarter pages. We discovered that because of an ambiguous driver installation procedure, we had inadvertently installed the Windows 3.1 drivers on our Windows 95 test-bed. After installing the proper Windows 95 drivers, we still had trouble printing all the elements of pages created in programs such as Freelance Graphics. By changing two of the driver's default settings (resetting the graphics switch from vector to raster, and TrueType fonts from bitmap soft fonts to graphics), the unit was able to print out everything we threw at it. Still, many users will be tripped up by these quirks.

In most paper-handling tasks, we found the DocuPrint 4508 to be reasonably adroit. The 250-sheet standard bin feeder is perfect for business needs and can handle a variety of paper sizes, including oversize letter and legal sheets. You have to feed envelopes and transparencies one at a time through the front slot, so if you print a lot of envelopes this isn't for you.

The DocuPrint turned out crisp, clear halftones and graphics, though small 6-point typefaces, while clearly legible, lacked some of the saturation and crispness we saw from competing printers. The printer also had a tendency toward some minor banding on intensive gray-scale pages. Still output quality is more than suitable for typical business needs.

The DocuPrint 4508 turned in average times in standard business printing tasks with Word and Excel documents. In graphics printing its performance slowed considerably; the printer took more than twice as long as others in its class to print our test documents.

The DocuPrint 4508 is a solid unit and offers features that any business user would need, though you can get better, faster print and an easier software setup from the HP LaserJet 6P.—*JRQ*

Xerox DocuPrint 4508. List price: \$799.99. Xerox Corporation, Rochester, NY; 800-349-3769; fax, 716-442-1339; www.xerox.com. Circle 456 on reader service card.



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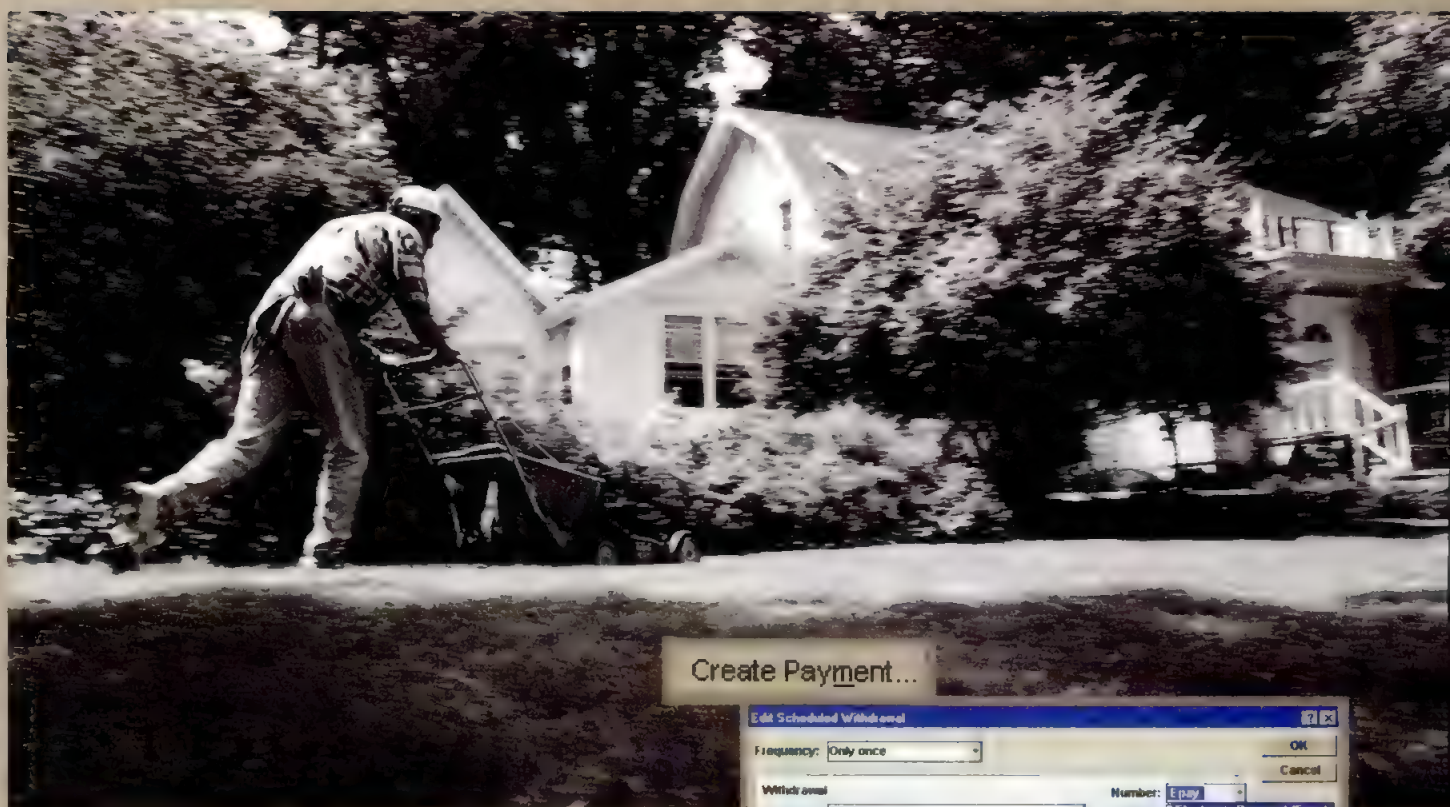
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A Solution for SOHO

If you're truly practical, what intrigues you most about hiring a one-man band is not the music but the payroll. Likewise, when you run the financials on the five multifunction printer/fax/scanner/copier machines we review here, they will impress you with their economy. For no more than you'd pay for a good plain-paper fax machine plus a printer for your PC, you get a wealth of features and functionality in one box that does it all. Along the way, you also save desk space and simplify the process of getting all of the modern office's electronic wonders working together.

Multifunction printers have had the reputation of jacks-of-all-trades that master none. But times and philosophies have changed with these second-generation devices. While multifunction technology once meant gluing a parallel cable onto a fax machine, the new way welds a fax machine on top of a PC printer. The big difference appears where it counts—on paper. These machines' output looks as good as that of any dedicated PC printer.

You also get clean faxes on plain

Small-office and home-office users can economize with one of these compact, affordable multifunction devices.

By Winn L. Rosch

paper, along with the ability to send faxes as simply and reliably as with a dedicated fax machine. If you've ever missed an incoming fax or had an outgoing fax truncated because of an internal PC fax board, you know how frustrating that piece of hardware can be. These units remedy that headache and also take the form of a familiar piece of equipment that everyone in the house or office can use, not just the PC-literate.

This generation of multifunction peripherals is still not perfect, though. For most of these machines, functions other

than printing and faxing—most often copying and scanning—are bonuses at best. You get plain-paper copies, but slowly and with an appearance that only an eye patch will help. And the monochrome-only, low-resolution scanning capabilities are best suited to occasional OCR tasks.

REVIEW CRITERIA

We selected five representative multifunction printers from the largest vendors, machines aimed primarily at the single-user home office or branch office. At minimum, we asked for PC printing and standalone faxing with at least one other function, and the units had to have a street price of less than \$1,000. Our picks include the Brother MFC 4550, the Canon MultiPass C2500, the HP OfficeJet 350, the Sharp F-2700M, and the Xerox Document WorkCenter 250.

All function as "convenience" copiers (good enough for the occasional copy in a pinch), and all except the Sharp unit provide scanning and PC-based faxing. Canon's is the only multifunction ma-

chine in this price range to deliver color output. Lexmark International was the first vendor to offer a color ink jet-based multifunction (the Medley), but it has since exited the market. Okidata, which pioneered the market four years ago with its Doc-It (a \$4,000 machine that required a coprocessor board in your PC), exited the market, too, though the company plans a new entry in 1997.

Considered as standalone fax machines, all five units proved competitive both with one another and with dedicated fax hardware. In fact, unplug the cable to your PC and each is the same as a standalone fax machine.

These products' printers match the quality of moderately priced personal ink jets or lasers, with resolutions as high as 720 by 360 dots per inch (dpi)—exactly what you would expect, considering that all five units are essentially based on the concept of PC printers. The Canon, HP, and Xerox units use ink jet printing technology; the Brother and Sharp machines are laser-based.

For making copies, the manufacturers simply link the fax scanner to the printer, as do fax machines that offer convenience copying. Unlike regular fax machines, though, these provide an indirect connection, which detours through the microprocessor and memory. This scenic route adds versatility: You can make multiple copies (up to 99 on each machine) and, with most of the units, alter the size of the image.

The four machines that offer scanning use their fax scanners to direct image data into your PC. This expediency limits the scanning to separate sheets of paper, and your scans can be only fax-quality—that is, coarse. None of these machines can scan at more than 400 by 400 dpi, even with interpolation. Gray-scale rendering is similarly restricted: The best machines allow for only 64 shades. Think of them as convenience scanners.

BROTHER MFC 4550

No need for suspense: Brother International Corp.'s Brother MFC 4550 proved best on our tests and deserves Editors' Choice. Its top-quality 600-dpi laser printing and 6-ppm speed aren't the only reasons. Brother has endowed the MFC 4550 with the best-built hardware and the best-thought-out software. It's designed as if

Editors' Choice

• Brother MFC 4550



The new crop of multifunction printers addresses the output-quality and ease-of-use shortcomings that hampered earlier efforts.

The Brother MFC 4550 (\$800 street) has it all—speed, quality, sturdiness, and software support. With its 6-ppm laser engine and its 600-dpi output, it's the best overall choice for SOHO users who need professional-quality printouts of business letters from a multifunction device.

The ink jet-based machines are appreciably less expensive, and that should make them more appealing at the practical level. Two in particular deserve an honorable mention. The color ink jet-based Canon MultiPass C2500 (\$600 street) is a good package for the home-office PC that doubles as the family PC. Select the Xerox Document Work-Center 250 (\$549 list) for its sturdiness and versatility if you don't mind the less convenient software installation and having to use both a parallel and serial cable.

Big Brother was watching you, saw exactly what you needed in your home or small office, and put it into the MFC 4550. Heavy discounting reduces the \$1,399 list price to under \$800 on the street.

The printer is a superb, 600-dpi laser. On our tests, its output quality really made the difference between lasers and ink jets stand out, producing a superior on-paper crispness despite the similarity in resolution ratings between the two types of printer. The MFC 4550 also proved the roundup's fastest printer and the one best able to keep up with a flow of incoming faxes. Its single limitation is that it is a Windows-only printer. It supplies neither driver nor emulation for direct DOS printing, though you can print from a DOS box within Windows. Also note that the MFC-4550 requires at least a 486/66 machine equipped with 8MB of RAM to run; with the other devices here you can get by with a 386 with 4MB of RAM.

Although you can replace the \$33.99 toner cartridge (good for 2,200 pages) and the \$192.99 imaging drum (good for 20,000 pages) separately, they fit together as a unit that drops into place easily. The machine automatically peels off the protective cover, which that keeps stray toner completely away from your manicure, your fingers, and anything you might touch for the rest of the day.

Brother has worked to make this as familiar as any fax machine, including 36 speed-dial numbers, 24 one-button-dial-

ing numbers, and a handset that lets you negotiate your calls before switching to the 14,400-bps internal fax modem. You can also connect all your other telephone appliances to the system—including telephone, modem, and answering machine—so that they share one line. Another model, the \$1,000 MFC 6550MC, includes a built-in digital answering machine with a 15-minute recording capacity, as well as other enhancements.

The fax/scanner mechanism sits atop the printer, and its straight paper path provides the best paper handling of these machines: It not only loads 30 sheets but also stacks them neatly when it finishes (with no risk of anything falling on the floor). The 756K fax memory holds about 20 pages. It integrates with the printer memory, so that one upgrade benefits both.

In faxing or scanning, this mechanism proved a smooth operator with none of the hesitant jerkiness of lesser machines. One result was that continuous tones showed little banding in scans or photocopies.

Brother's proprietary Multi-Function Link PRO software tightly couples the MFC 4550 with your PC, even transferring settings you choose on the fax machine to your computer. It also includes all of the PC fax features you should expect—a phone book, a scheduler, and a log.

The software also permits intimate control of the MFC 4550's scanning. It allows prescans and limited-area scanning, and it adroitly handles multipage scans.



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COVER STORY

Multifunction Printers

The 200- by 400-dpi resolution (400 by 400 interpolated resolution) limits the quality of scanned images. Thanks to its print engine, the MFC 4550 was also the fastest copier: We waited less than 20 seconds for the first page to roll out. In addition, it made the best-looking copies, and it can reduce or enlarge copies.

Best of all, the MFC 4550 has the feel of a machine on which you can depend. This sturdy unit is built like office equipment and will probably survive more abuse or just normal wear than the other contenders. It's a machine designed to work, and work hard.

CANON MULTIPASS C2500

One word summarizes the Canon MultiPass C2500 as to what makes it stand out, what it does best, and why you might buy it: *color*. Canon based the \$599 (list price) C2500, the only one of these multifunction machines that provides color output, on its midrange BJC-4000 series of ink jet print-

ers. If you want a home machine that will serve the family PC, and if you think that the added functions are worth having around, the C2500 is your best bet.

The C2500 offers good output quality: 720- by 360-dpi resolution with smoothing, although you need special paper to get all the detail. Text is black and sharp, including large characters, though banding is discernible (even objectionable) in graphics printouts. Print speed, claimed at 5 ppm for monochrome and 0.8 ppm for color, proved modest for monochrome (the slowest of the machines in this survey) and a test of our patience for color. We waited more than 8 minutes for each of our 100 percent-coverage color test pages.

You can send your first fax as easily as punching in the appropriate number. Or you can link the C2500 to your PC using Canon's MultiPass software for PC fax control. Programming the C2500 from the Windows interface is easy, and the software includes all the features you should expect

in a PC fax system. Programming the C2500 fax machine from its push-button pad is another matter. Although it is easy with regard to the basic functions, such as simple faxing, mastering all the options makes programming a VCR look simple.

When you want to transmit a fax, the C2500 leaps immediately into action, scanning into its memory while dialing and negotiating the connection at up to 14,400 bps. You can load up to 20 sheets for faxing, scanning, or copying into the C2500's top tray. After scanning, the sheets slide out of the front of the machine into a dish-shaped tray; it is too short for even letter-size sheets, so they flutter to the floor, one after another.

Printer and fax paper feeds into a covered bottom tray and slides out of the front of the machine, on top of the feed tray. Paper pops out printed-side up, which means you have to collate by hand.

The C2500's scanner resolution, 203 by 196 dpi, limits the quality of scans, although

MULTIFUNCTION PRINTER SAMPLES

With its 600-dpi laser engine, the Brother MFC 4550 was the hands-down winner in monochrome output quality. Text is clean and sharp, and the graphic shows good detail. The 300-dpi Sharp F-2700M laser engine also produced professional-caliber text output, though upon close inspection the lower resolution is noticeable.

Among the ink jet-based trio, the HP OfficeJet 350 was the leader if you opted for ink jet paper; the ink tended to wick into copier paper, giving text a fuzzy appearance.



Brother MFC 4550



Canon MultiPass C2500



HP OfficeJet 350



Sharp F-2700M



Xerox Document WorkCenter 250

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Multifunction Printers

interpolation boosts rated copy quality to 300 dpi. While the machine prints in color, scanning is black-and-white only. The unit is rated at 64 shades of gray for copying; we were able to discern 10 on the screen using Canon's MultiPass software. Scanning takes about 30 seconds in halftone mode, but moving scanned data to your PC extends the total time to 54 seconds for a chart and to 85 seconds for an 8- by 10-inch photo scanned in halftone mode. Making a first photocopy of a page requires about 48 seconds, regardless of the graphics content. The C2500 will auto-reduce long sheets to fit standard paper but works only in one dimension, compressing height but leaving image width as it was. Although this distorts the aspect ratio, it makes for larger, more legible images.

HP OFFICEJET 350

If you like Hewlett-Packard's DeskJet printers, you'll feel an immediate affinity with its HP OfficeJet 350. This machine's

bottom level and internal printer mechanism are derived from the DeskJet line, and the output of the OfficeJet (\$665 list, about \$550 on the street) matches that of the HP ink jet printer line. You get the same 600-by 300-dpi quality, as well as Resolution Enhancement Technology and almost ubiquitous support for other drivers.

As with current DeskJets, the OfficeJet's paper path for printing starts in the lowest tray (which holds up to 100 sheets) and ends in a "tray" just above it, which is actually the input tray's cover. The sheets emerge facedown and are thus properly collated. The paper trays' plastic feels particularly flimsy: The input tray's edge guide is difficult to move and tends to warp single sheets. That tray works just as effectively with envelopes and transparency sheets (20 at a time).

You need coated paper or transparencies to see all that the OfficeJet can render. Bond paper absorbs enough ink to make character edges fuzzy and to soak through

poorly chosen stock. And the OfficeJet did not live up to its 3-ppm rating, even with text: It printed a five-page text at 2 ppm and a newsletter at just over 1 ppm. The software supports only PCL 3; it does not provide scalable fonts or support HP-GL.

When you need to fax, you can take manual control using a full 16-button telephone keypad, 8 dedicated function keys, a menu button, a green Start button and a red Stop button, and a 20-character, 2-line LCD readout. You can send a fax or make a copy from the OfficeJet without the intervention of your PC, simply by loading the sheet-feeder and pressing Start. Speed dialing from the OfficeJet front panel supports up to 60 numbers, with the first 10 given a dedicated pad on the far right of the control panel. The system also remembers five groups of numbers. Although the OfficeJet recognizes distinctive ringing, the only options are routing multiple rings to the fax and sending single rings to the telephone.

PERFORMANCE TESTS

Multifunction Printers



The two laser-based units, the Brother MFC 4550 and Sharp F-2700M, generally outpaced the ink jet-equipped units. Print speed differences on our Microsoft Word for Windows and Microsoft Publisher

Newsletter tests were marked, with the laser printers taking about half as long as the ink jets to produce our test documents.

Fax speed results were more tightly grouped, as the 14.4-Kbps Brother and Canon MultiPass C2500 topped the 9,600-bps competitors. Copy and scan speeds varied more widely, and all these units are significantly slower than dedicated copiers or scanners.

How We Tested

We performed tests on an HP Vectra Pentium/90 with 16MB of RAM, using a 1GB Quantum hard disk and running Windows 95. We set the HP BIOS to ECP to comply with the 1284 IEEE standard and to allow for bidirectional printing. We tested printers at their default resolution and driver settings.

The **Microsoft Word for Windows** test times a printer's production of a five-page text document with different fonts and typefaces.

The **Microsoft Publisher Newsletter** test times a printer's production of a one-page newsletter containing text, graphics, and a bitmapped photo.

The **Fax Speed** test times a unit's faxing of a five-page text.

The **Copy Speed** test times a unit's production of one photocopy of the industry-standard A&P International Scanner Test Target PM-189, a complex test page that contains text, line art, and gray-scale elements.

The **Line Art Scan Speed** test times a unit's scanning of that page.

The **Photo Scan Speed** test times a unit's scanning of an 8- by 10-inch color photo (in halftone mode).

	Microsoft Word for Windows (5 pages)	Microsoft Publisher Newsletter (1 page)	Fax Speed (5 pages)	Copy Speed (1 page)	Line-Art Scan Speed (1 page)	Photo Scan Speed (1 page)
Brother MFC 4550	1:12	0:43	1:50	0:19	0:36	6:35
Canon MultiPass C2500	3:10	2:02	1:56	0:49	1:12	2:24
HP OfficeJet 350	2:31	1:07	2:27	0:30	1:09	2:19
Sharp F-2700M	1:24	0:38	2:18	0:39	N/A	N/A
Xerox Document WorkCenter 250	2:40	0:48	2:37	0:51	1:43	2:35
	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER	◀ BETTER

N/A—Not applicable: The product does not have this feature.

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If you want to involve your PC, just insert a page in the scanner and a menu will pop on your screen asking whether you want to copy, fax, or scan. You can switch off the AutoPrompt pop-up feature but still retain control through manually loaded HP OfficeJet Manager software. Although this software is comprehensive and integrates the unit's functions well, it has its weaknesses. For example, if you make an error in feeding a sheet to the scanner and try to clear it, the program will have forgotten your adjustments and even your filename for the scan.

Backup fax reception spools incoming documents to disk, augmenting the meager 24-page fax memory. HP includes Phoenix Eclipse FAX SE software, so you can use the OfficeJet's 9,600-bps modem for PC fax communications and have all of the usual options.

The OfficeJet was the slowest copier of the lot, requiring 50 seconds to complete a document's first page. It can reduce images only to 70 percent of the original size, and it cannot enlarge. During fax reception, the OfficeJet reduces images so that legal-size faxes fit on letter-size sheets.

If you're as picky as we are, you can find fault with the OfficeJet. Foremost, better plain-paper output quality and greater speed would have been welcome. But if you want one machine to handle your printing, faxing, and occasional copying needs, the OfficeJet will handle its assignment adroitly.

SHARP F-2700M

Compared with the other products in this group, the laser printer-based Sharp F-2700M stands out as to what it does not include. Sharp does not claim that the F-2700M is a scanner or that it provides driver or other software support. Nor does Sharp supply PC fax software. The F-2700M's fax functions are completely independent of your PC and cannot be controlled by it. Sharp doesn't even expressly provide for printing envelopes or transparencies.

These omissions make it imperative that the expensive F-2700M (list price \$1,249, street price \$1,000) do well with the three features it does include: printer, standalone fax, and copier. In fact, it handles its appointed chores well but, in face of the strong competition, stands out in none of them.

SUMMARY OF FEATURES

Multifunction Printers

PC MAGAZINE
EDITORS' CHOICE

■ YES ■ NO	Brother MFC 4550	Canon MultiPass C2500	HP OfficeJet 350	Sharp F-2700M	Xerox Document WorkCenter 250
Products listed in alphabetical order					
List price/Street price	\$1,399, \$800	N/A, \$600	\$725, \$600	\$1,249, \$1,000	\$549, N/A
Dimensions (HWD, in inches)	15.1 x 17.8 x 9.9	14.0 x 15.6 x 19.0	11.1 x 17.3 x 15.5	8.3 x 14.2 x 16.2	15.0 x 16.0 x 18.0
Weight (pounds)	18.8	16.7	19.5	15.9	23.0
Printing					
Technology	Laser	Ink jet	Ink jet	Laser	Ink jet
Prints in color	■	■	■	■	■
Monochrome resolution (dpi)	600 x 600	720 x 360	600 x 300	300 x 300	300 x 300
Rated monochrome speed (ppm)	6	5	3	4	3
Operating systems supported	Windows	Windows, DOS	Windows, DOS	Windows	Windows, DOS
Printer emulation support	None	Epson LQ2550, IBM ProPrinter	PCL 3	PCL 4	PCL 5
Memory specification	756K	None	256K	256K	512K
Capacity of each input/output tray	200, 100	150, 150	100, 100	100, 100	100, 100
Auto-feed capacity for transparencies/envelopes	50, 20	50, 20	20, 20	Not rated	Not rated
Faxing					
Modem speed (bps)	14,400	14,400	9,600	9,600	9,600
Transmission speed (seconds per page)	6	6	10	13	10
Reception speed (ppm)	6	4	3	4	3
Memory/feeder capacity (pages)	20, 30	42, 20	24, 20	39, 20	35, 20
Software supplied	Brother MultiFunction Link Pro	Canon MultiPass Desktop Manager	HP OfficeJet Manager, Phoenix Eclipse FAX SE	None	Delrina WinFax Lite
Speed-dial/One-button numbers	36, 24	90, 16	65, 10	30, 20	100, 10
Speed-dials through software	■	■	■	■	■
Auto-redials through software	■	■	■	■	■
Faxes while printing/scanning/copying	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Scanning					
Highest scan resolution (dpi)	400 x 400	203 x 196	300 x 300	N/A	300 x 300
Rated speed	8 ppm	2 ppm	Not rated	N/A	6 ppm
Number of gray shades	64	64	32	N/A	64
Software supplied	Brother MultiFunction Link Pro	Canon MultiPass Desktop Manager	Caere OCR	N/A	Xerox TextBridge Professional Edition
Adjustments available	Prescanning, inversion, rotation	Rotation	Rotation	N/A	Rotation
Copying					
Rated speed (seconds per page)	15	45	50	15	35
Maximum number of copies	99	99	99	99	99
Reduction and enlargement range	50%–200%	N/A	70%–100%	N/A	50%–200%
Resolution (dpi)	200 x 400	360 x 360	300 x 300	203 x 196	300 x 300

N/A—Not applicable: The product does not have this feature.

The machine's laser engine produces crisp images that outclass ink jet output despite being limited to 300-dpi resolution. Although slower on most printing tests than the Brother unit, the 4-ppm F-2700M actually held a slight edge in graphics printing speed. The root of this is the F-2700M's use of the Windows Printing System (WPS), which divides printing chores between the host PC and the printer. It also enables the F-2700M to deliver full-page graphics at its highest resolution, despite

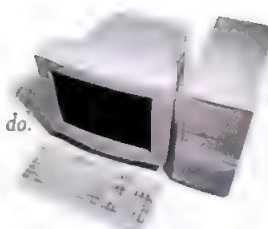
having only 512K of printer memory. You can install the WPS software quickly from three floppy disks; it includes separate PCL 3 emulation for printing from DOS.

The Sharp laser engine uses a separate \$90 imaging drum (good for 20,000 pages) and a \$65 toner cartridge (good for 2,000 pages). Changing the two-piece cartridge is a bit complicated because you must remove and reinstall a plastic paper guide. The process is reasonably well thought out, but the first time we tried it, we



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COVER STORY
Multifunction Printers

couldn't completely pull out a rubber tab on the toner cartridge.

The printer paper path is straight. Sheets move from a rear 100-sheet vertical tray to a tray in front of it, and one slowly enters as another exits. Pages move so smoothly that the machine seems to be sucking through one long sheet. Printer output stacks facedown, so you don't have to bother with collating. The scanner path is straight, too, but there is no tray to receive the 20 sheets that the mechanism can handle.

As a standalone fax machine, the F-2700M operates exactly as you'd expect: Punch in a number, press a button, and it passes through all the pages you can load. You can program 30 speed-dial numbers and 20 one-button numbers on its keypads, as well as other fax functions. But the F-2700M does not accept PC fax data and provides no fax control for its 9,600-bps modem from your PC.

The F-2700M copier operates at high fax resolution (203 by 196 dpi); thanks to the laser engine, it also produced its first page fast, in about 30 seconds. Features consist only of multiple copying (up to 99 copies of a document), a 20-sheet feeder, and size adjustment for fitting images from larger pages (legal- or A4-size) onto letter-size sheets.

At 6.7 by 14.2 by 16.2 inches (HWD), the F-2700M is the most compact, space-saving unit in this survey, and it feels surprisingly sturdy despite being the lightest in weight. Still, the F-2700M doesn't win any medals in this competition, and in view of its price, it should.

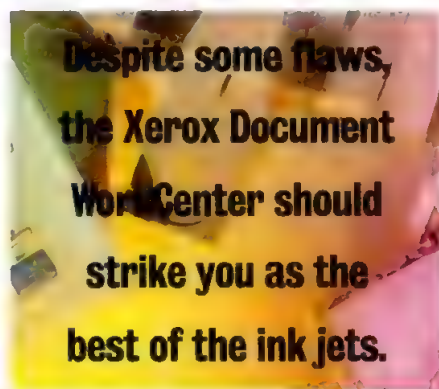
XEROX DOCUMENT WORKCENTER 250

When it debuted over a year ago, the clean and rugged Xerox Document WorkCenter 250 was the best multifunction printer to have come to market. It is still a fine machine, though when you compare it with the newer crop, it becomes obvious that Xerox needs to work on the details—namely, the interface and software. Otherwise, the WorkCenter would have been our pick as the best multifunction monochrome ink jet.

What you get for just \$549 (list) is a marvelous mechanism burdened by design oversights, such as an extra cord. The WorkCenter is the only reviewed unit still requiring both serial and parallel connections for its PC link, a throwback to the

last generation of multifunction machines. Moreover, although the unit includes all the appropriate features, the software has more loose ends than a frayed Persian rug.

The WorkCenter's printer core uses a 300-dpi ink jet engine whose rated speed is 3 ppm. Not only are both specs identical to those of HP's OfficeJet, but the two also ran neck and neck in performance tests, slower than the lasers but generally quicker than the Canon ink jet. Despite the WorkCenter's low-resolution rating, its output quality proved competitive with that of the other ink jet machines, which have better specifications. It couldn't



match the lasers' output, however.

The design and construction of the WorkCenter's mechanism are far above those of the other ink jet-based machines and just short of the Brother laser's. But this sturdy mechanism, too, suffers in the details. For example, scanned or copied originals slide out onto the floor. And the WorkCenter cannot feed envelopes automatically; you insert them singly through the manual-feed slot, which you access by pulling down the guides for the scanner.

As a standalone fax machine, the WorkCenter provides all the standard functions, including up to 100 speed-dial numbers and one-button access to 10 of them. You can also use its 9,600-bps modem as part of a PC fax system by using the Delrina WinFax LITE software supplied with it.

Xerox rates the copier at 300-dpi resolution. It claims that the unit produces a document's first page in 35 seconds, but in testing, the WorkCenter needed almost 50 seconds for a full-page copy. The machine reduces and enlarges from 50 to 200 percent of the original size. The WorkCenter's fax/copier scanner accepts only three paper sizes for automatic feeding—

letter, legal, and A4—but works with manually fed pages as narrow as 4 inches.

The relatively quick scanner (6 ppm) distinguishes up to 64 shades of gray at its highest resolution, 300 dpi. As a bonus, Xerox includes its TextBridge Pro OCR software. In addition to recognizing printed text, the software also reconstructs original page layout (including tables) in many word processing and worksheet formats. Although this software performs only rudimentary graphics editing, the WorkCenter automatically installs a Twain driver, which enables you to use the scanner with most applications such as Photoshop.

To make the WorkCenter a winner, someone at Xerox will have to sit down and check the details. For example, the disks that Xerox provides do not correspond with the documented installation procedure. And Windows 95 does not automatically recognize the WorkCenter as new hardware, or even as a printer, after you connect it and boot up; this is not the case with the other reviewed multifunction printers. Although installing the software takes the standard form of running setup from drive A:, you may still have to set the WorkCenter manually as your default printer.

If you can give up an extra port and can overlook the loose ends, the Xerox Document WorkCenter 250 should strike you as the best of the ink jets—smooth-running and sturdy enough for tough office use.

Brother MFC 4550. List price: \$1,399. Brother International Corp., Somerset, NJ; 800-284-4329, 908-356-8880; www.brother.com. *Circle 447 on reader service card.*
Canon MultiPass C2500. List price: \$599. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; www.ccsi.canon.com. *Circle 448 on reader service card.*

HP OfficeJet 350. List price: \$725. Hewlett-Packard Co., Santa Clara, CA; 800-752-0900, 208-323-2551; www.hp.com. *Circle 450 on reader service card.*

Sharp F-2700M. List price: \$1,249. Sharp Electronics Corp., Mahwah, NJ; 800-237-4277, 201-529-8200; www.sharp-usa.com. *Circle 457 on reader service card.*

Xerox Document WorkCenter 250. List price: \$549. Xerox Corp., Palo Alto, CA; 800-832-6979, 415-813-6800; www.xerox.com/products/dwc250. *Circle 456 on reader service card.*



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Horizontal Scan Rate	30-115 KHz	30-95 KHz	30-95 KHz	24-82 KHz	30-85 KHz
Video Input Bandwidth	250 MHz	200 MHz	200 MHz	135 MHz	135 MHz
Recommended Resolution	1800 x 1440 @ 75Hz	1600 x 1200 @ 76Hz	1600 x 1200 @ 77Hz	1280 x 1024 @ 77Hz	1280 x 1024 @ 80Hz
MSRP**	\$2,195	\$1,845	\$1,895	\$895	\$799

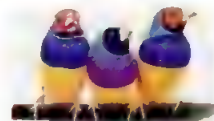
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Winner
ViewSonic P815
June 1996



Winner
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June 1996



ViewSonic®

Service & Reliability

Still not sure which printer to buy?

Our readers let us know how the vendors rate in terms of customer service and product reliability.

By Rebecca Acselrod and Holly Aguirre

Our preceding reviews reveal a fairly high level of competence among laser and ink jet printers, most of which do a pretty good job of laying down text and graphics. That's why our Service and Reliability section is so significant: It's a key differentiator among vendors.

Each year we survey readers at random and ask them to report on the printers they have used in the past two years. This year, we mailed the survey to 17,000 *PC Magazine* subscribers, and over 8,500 responded. We received ratings on nearly 18,000 printers and tabulated results for the 18 vendors that received 50 or more mentions. (See the sidebar "How Readers

Rated the Printer Vendors" for a detailed explanation of our methodology).

As in past Service and Reliability studies, we asked subscribers to rate their printers based on their satisfaction with overall reliability, satisfaction with repair experience, and satisfaction with technical support. Last year we added a fourth measure, the number of repairs a printer needed in the first 12 months of use. This year, to reflect recent experiences better, we changed this fourth category to represent the number of repairs needed in the past 12 months.

The Readers' Report Card grade is based on those four measures. To merit an A—a rarity—a vendor must receive

READERS' REPORT CARD	
A	Epson Hewlett-Packard
B	Apple Canon Lexmark Panasonic Star Micronics
C	Xerox Citizen America Digital Tandy
D	Alps Brother NEC Okidata QMS Tektronix Texas Instruments

better-than-average scores on all four of the key measures. Obtaining a B results from a combination of better-than-average and average scores on the four measures and indicates a fine performance overall. A grade of C indicates all average scores, or a combination of better-than-average, average, and worse-than-

SURVEY RESULTS

How Readers Rated the Printer Vendors

In February 1996 we mailed questionnaires to a randomly selected sample of 17,000 *PC Magazine* subscribers. The survey was closed for tabulation on April 5, by which time we had received a 50 percent response rate. Willard and Shulman, a research firm based in Greenwich, Connecticut, tabulated the survey.

Each subscriber described up to five printers used over the past two years. Then, on a scale of 1 (worst) to 10 (best), respondents rated their satisfaction with printer reliability, repair experience, and technical support received.

Only vendors for which we received at least 50 responses—which we considered the minimum amount of data necessary to produce statistically reliable results—were included in the final tabulations. We report the survey findings in terms of how ratings for each PC manufacturer compare with the overall average. We made these designations using a t-test, a standard statistical procedure used to identify differences from the average that are significant at the 95 percent confidence level.

T-tests take into consideration the ratings, the amount of variation among the ratings, and the number of ratings received. These components determine the confidence interval for each score, or the range into which we are 95 percent certain that the score falls. The fewer the ratings and the greater the amount of variation among the ratings, the larger the range will be. Only when the range is entirely above or below the overall average is the vendor's score considered significantly different from the average. Therefore, it is possible for one product to appear in the average range while another with the same score emerges as significantly above average, or for a vendor with a lower score to be above average while one with a higher score is not. —Rachel Derby Teitler

● Significantly better than average ○ Average ● Significantly worse than average

Vendor (and number of responses)	Reliability	Repair	Tech support	Units needing repair	Buy again?
Alps (52)	7.3 ●	7.8 ○	7.0 ○	13% ○	4.4 ●
Apple (333)	8.4 ○	7.8 ○	8.0 ○	15% ●	6.7 ○
Brother (296)	8.4 ○	7.1 ●	7.3 ○	19% ○	7.6 ●
Canon (1,430)	8.5 ●	8.3 ●	8.0 ○	13% ●	8.2 ●
Citizen America (205)	8.3 ○	7.8 ○	8.1 ○	18% ○	8.5 ●
Digital (144)	8.3 ○	7.5 ○	7.4 ○	23% ○	6.9 ○
Epson (2,264)	8.6 ●	8.0 ●	8.2 ●	12% ●	7.8 ●
Hewlett-Packard (8,425)	9.2 ●	8.8 ●	8.7 ●	15% ●	9.3 ●
Lexmark (649)	8.6 ●	8.2 ●	8.3 ●	21% ○	7.7 ●
NEC (261)	8.3 ○	7.1 ●	7.2 ○	16% ○	6.4 ●
Okidata (787)	8.4 ○	7.7 ○	7.8 ○	23% ●	7.2 ○
Panasonic (1,455)	8.4 ●	7.6 ○	7.5 ○	14% ●	6.9 ○
QMS (142)	7.8 ●	7.0 ●	7.5 ○	36% ●	6.4 ●
Star Micronics (251)	8.2 ○	7.9 ○	7.1 ○	14% ●	6.3 ●
Tandy (103)	7.6 ●	7.2 ○	7.0 ○	9% ●	5.0 ●
Tektronix (127)	8.4 ○	7.8 ○	8.1 ○	33% ●	7.9 ●
Texas Instruments (135)	8.1 ○	7.3 ○	7.4 ○	30% ●	6.6 ○
Xerox (80)	8.6 ●	8.4 ●	8.4 ○	34% ●	7.5 ○
AVERAGE	8.3	7.7	7.7	20%	7.0



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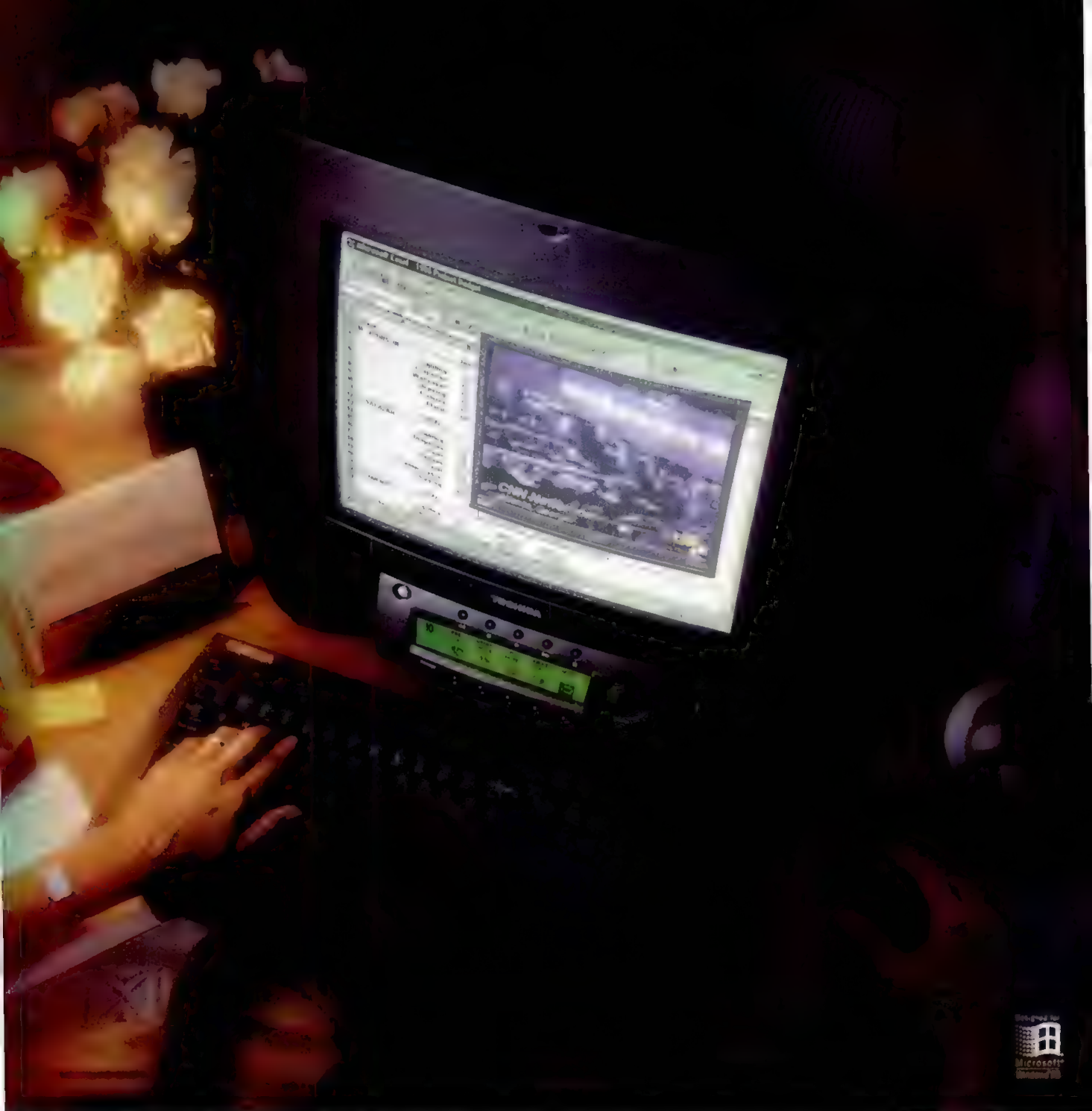
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CIRCLE 378 ON READER SERVICE CARD

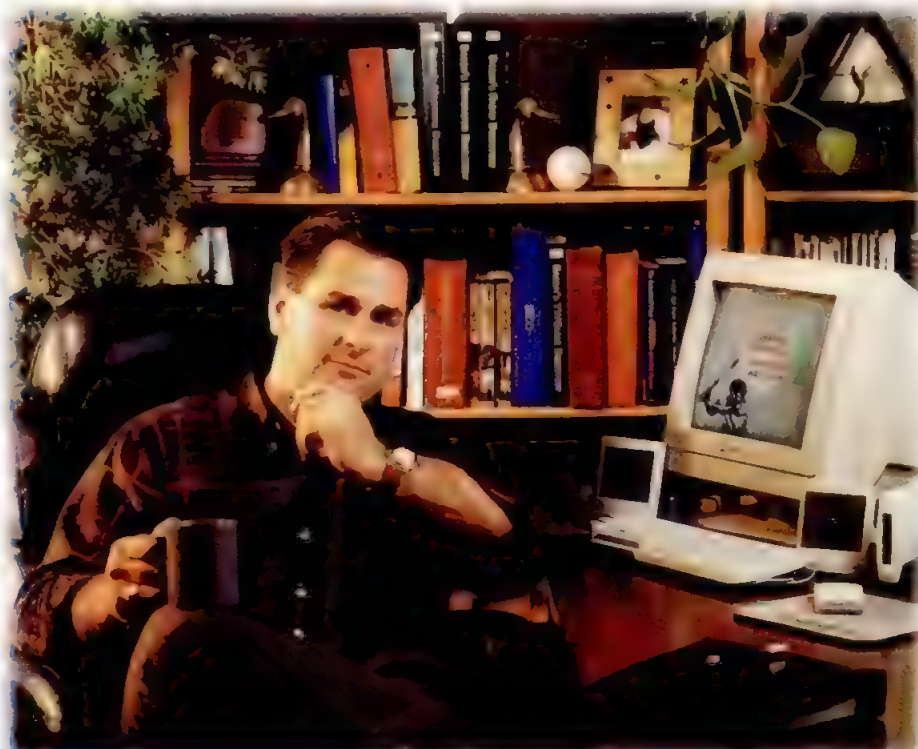
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CIRCLE 036 ON READER SERVICE CARD

VENDOR GRADES

Past and Present

	1996	1995	1994
Alps	D	D	C
Apple	B	B	C
Brother	D	C	N/A
Canon	B	A	C
Citizen America	C	C	C
Digital	C	B	B
Epson	A	A	A
Hewlett-Packard	A	A	A
Lexmark	B	B	D
NEC	D	C	D
Okidata	D	B	C
Panasonic	B	B	B
QMS	D	C	C
Star Micronics	B	B	C
Tandy	C	D	D
Tektronix	D	D	N/A
Texas Instruments	D	C	C
Xerox	C	N/A	N/A

N/A—Not applicable. We did not receive 50 responses for this vendor, the minimum needed for inclusion in our survey results.

average. And finally, a combination of average and worse-than-average scores results in a grade of D. This year, as with last, no vendor receives four worse-than-average scores, which would have meant a grade of E.

Only Epson and Hewlett-Packard emerge with A's this year; both companies maintain their grade from last year by earning better-than-average scores on all four measures. Printer-market leader Hewlett-Packard receives 49 percent of the mentions—the most of any vendor in this survey. Epson, its closest competitor, receives 13 percent of the responses.

Five vendors receive a grade of B: Apple, Canon, Lexmark, Panasonic, and Star Micronics. Canon received a grade of A last year, but in this year's survey readers' satisfaction with its technical support has slipped from above average to average, which brings Canon's overall grade down a notch.

Repeating their B performances from last year, Apple and Star Micronics receive average scores for satisfaction with

reliability, repair experience, and technical support but have better-than-average scores for past-12-months repairs. Lexmark has remained consistent from last year as well, receiving its B grade by scoring better than average for satisfaction with reliability as well as with repair and tech support, and emerging as average for past-12-months repairs. Rounding out the B category is Panasonic, another familiar face, scoring better than average for reliability and past-12-months repairs, besides gaining average scores for tech support and overall repair experience.

Xerox joins our survey for the first time this year with a better-than-average score for satisfaction with repairs, an average score for satisfaction with reliability and tech support, and a worse-than-average score for past-12-months repairs. This combination gives Xerox an overall grade of C on our Readers' Report Card. Accompanying Xerox are Citizen, Digital, and Tandy. Citizen is the only repeat performer among the C group, with Digital dropping from its last year's position at B and Tandy coming up from the D ranks. Citizen maintains its ranking with average scores across all four measures, experiencing no change from last year's standing.

Digital, which received a grade of B last year, falls to a C because its satisfaction-with-tech-support score dropped from better than average to average. It receives average scores for satisfaction with reliability and repair experience and for past-12-months repairs.

For two consecutive years, Tandy has received a D on our report card. This year its scores for satisfaction with repair experience and tech support show marked improvement: Both have risen from worse than average to average.

At the bottom of the report card, vendors receiving a combination of average and worse-than-average scores to register a grade of D are Alps, Brother, NEC, Okidata, QMS, Tektronix, and Texas Instruments. Alps and Tektronix received a grade of D last year but now show some improvement. Alps has improved its satisfaction-with-repair-experience score

from worse than average to average. Tektronix, which specializes in high-end color printers, has improved from worse than average to average for satisfaction with reliability. It maintains its average scores for satisfaction with repair and tech support but receives a worse-than-average score for past-12-months repairs.

Okidata has seen a lot of fluctuation over the years, having achieved B status last year but slipping to D this year. It receives a worse-than-average score for past-12-months repairs, and its reliability score falls from better than average to average. Okidata does, however, maintain its average scores for satisfaction with repair experience and tech support.

Brother and NEC both received a grade of C last year and drop to D this year as their scores for satisfaction with repair experience fall from average to worse than average. Both maintain their average scores for satisfaction with reliability and tech support and receive average scores for past-12-months repairs.

Texas Instruments also drops from a C

SERVICE & RELIABILITY

How Long Will You Wait on Hold?

Average times our readers waited on the phone before being connected to a live tech-support person.

		Minutes on hold
Significantly better than average	➤	
Average	○	
Significantly worse than average	➤	
Alps	4	➤
Apple	5	➤
Brother	15	➤
Canon	13	➤
Citizen America	8	○
Digital	6	○
Epson	13	➤
Hewlett-Packard	8	➤
Lexmark	9	○
NEC	14	○
Okidata	10	○
Panasonic	10	○
QMS	10	○
Star Micronics	15	○
Tandy	9	○
Tektronix	8	➤
Texas Instruments	9	○
Xerox	4	➤
AVERAGE	9	

Our Contributors: REBECCA ACSELROD is a project manager and RACHEL DERBY TEITLER is the research manager at Ziff-Davis Publishing Co. HOLLY AGUIRRE is a staff editor at *PC Magazine*.

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to a D this year. Its decline comes as a result of a worse-than-average score for past-12-months repairs, down from last year's average score for first-year repairs. Texas Instruments recently sold its printer business to Genicom.

QMS falters in the customer-satisfaction department this year. After receiving a C last year, QMS now garners a D due to drops in its scores for satisfaction with reliability and repair experience: Reliability and repair were average in 1995 but fall to worse than average this year. Readers also rate QMS worse than average in this year's past-12-months-repairs category. Only satisfaction with technical support remains unchanged, with an average score both years.

SATISFACTION BY PRINTER TYPE

We can also look at satisfaction criteria for different printer technologies. Laser and ink jet printers both perform better than average for satisfaction with reliability, repair experience, and tech support. Dot matrix printers perform worse than average on all three measures.

Thermal wax transfer, thermal dye, and solid ink printers have worse-than-average scores for satisfaction with reliability but average scores for satisfaction with both repair experience and tech support.

During the past 12 months, 20 percent of the 18,000 printers on which readers report needed repairs. According to our respondents, printers from seven vendors needed service less frequently than the average, performing significantly better than average on this measure: Apple, Canon, Epson, Hewlett-Packard, Panasonic, Star Micronics, and Tandy. Five vendors—Okidata, QMS, Tektronix, Texas Instruments, and Xerox—all score below average when it comes to needing a service call in the past 12 months, whether for a paper jam or an actual breakdown.

To have printers repaired, 41 percent of our readers called the manufacturer while 67 percent called someone else, such as a third-party service provider, a retailer, or a company's IS department. Issues were resolved over the phone for 15 percent of our readers, while 81 percent needed some kind of repair or a replacement part.

HOLD THE PHONE

Among the printers rated, 16 percent required a call to tech support in the past 12 months. Alps, Apple, Citizen, Epson, Hewlett-Packard, Panasonic, Star Micronics, and Tandy perform better than average in the need for technical support. Lexmark, QMS, Tektronix, Texas Instruments, and Xerox printers needed more tech support than the average.

Among those respondents who had one or more tech-support situations, 48 percent report that they spoke to knowledgeable people, 43 percent had their problems resolved promptly, and 37 percent spoke with someone extremely eager to help them. But 23 percent had to call more than once to get the tech support they needed, and 14 percent were transferred excessively.

Finally, readers rate Brother, Canon, Epson, Hewlett-Packard, Lexmark, and Tektronix as vendors from which they would be likely to buy again. Below average for the future likelihood of buying are Alps, Citizen, NEC, QMS, Star Micronics, and Tandy. □

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3-D ANIMATION SOFTWARE



MAKING BASIC SHAPES: Most 3-D animations start with basic solid objects (also known as *primitives*) like cubes, balls, and cones.

FREE-FORM MODELING: You can create other shapes by deforming these primitives, using combinations of polygons, or making free-form spline-based drawings.

BUILDING COMPLEX OBJECTS: Then you extrude, sweep, and lathe simple 2-D splines and shapes into solid and often symmetrical objects.

MAKING IT REAL: You add colors, textures (often in the form of image and bump maps) and other properties to the object. Additional adjustments of reflective, smoothness, and transparency values contribute to the realistic effect.

By Lori Grunin

Space may not be the final frontier for PC graphics, but it certainly bears further exploration in the software arena. From static images to games to virtual worlds on the World Wide Web, 3-D environments increasingly pervade our computing lives. The ability to circumnavigate objects adds a higher degree of realism and elegance to the ideas you convey, whether you're

flying through an architectural design for a client or creating alien landscapes for entertainment.

Out of a surprisingly large field of 3-D packages, we reviewed products that not only could perform modeling and keyframe animation (the process that blends separate frames into a fluid sequence) but could also provide some sort of time-line or keyframe overview of a project. We required the software to be capable of running under Microsoft Windows NT; though many of these programs also run under Windows 95, we believe that the present and future power of profession-

al graphics will be manifest on PCs running Windows NT. The days when SGI graphics workstations served as the sole

systems handling 3-D animation software are behind us. The forecast is bright for these PC-based applications, particularly among mainstream users.

THE PLAYERS

Eight products met our criteria. They vary in functionality as well as in price, ranging from under \$300 to over \$7,000. Professional-level packages generally offer far more power and flexibility for creating and animating organic shapes than entry-level ones do. The higher-priced packages—LightWave



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ng Shape



OPERATING IN 3-D SPACE: You must position objects, cameras, light, the ground plane, and sometimes backgrounds in simulated 3-D space. Users often accomplish this by using multiple views (top, left, right, side, and bottom).

MAKING IT MOVE: To animate your 3-D scene, you can often assign keyframes (or keyframes) that the 3-D application could note on a time line. Another method involves drawing a free-form path for your object to follow. In either case, the application will handle creating the frames that occur between the key actions to build a smooth animation. You can set the lights and cameras to follow objects, which, in turn, you can set to deform over time.

THE FINAL PRODUCT: Rendering your final scene is analogous to printing using a word processor. The 3-D application lets you define the quality of your output: how highly rendered it is and how many frames per second it has. You can also pick what kind of output you want—still image, animation, or even VRML for the Web.

3D, Softimage 3D, and 3D Studio MAX—let you edit the function curves that control such elements as the timing, rotation, and position of objects during animation.

These high-end packages are designed for work in production environments. They offer multiprocessor and geometry acceleration to speed up operation when working interactively with shaded objects, the ability to host a rendering farm (distributing rendering tasks to idle clients across a network), and—in the case of Softimage 3D—a database-centric design for managing large, multiperson projects. If your models will eventually end up in games, you'll appreciate these packages' ability to export to console-game and Direct 3-D-compatible formats.

But if you're a graphic designer creat-

ing static scenes, you don't necessarily need to shell out big bucks. As an illustrator, you may be far more comfortable with the inexpensive Ray Dream Studio—whose interface lets you draw cross sections on the "walls" of your 3-D space—than with 3D Studio MAX's CAD-like environment.

Or you may prefer the sculptural, free-form deformation tools available in trueSpace 2. And renderer quality, an essential component for the illustration crowd, varies widely irrespective of price. (For more details on rendering engines and quality, see the sidebar "How About Them Apples?")

In the past, the ability to extend a 3-D package with custom routines—such as third-party renderers and animation con-

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trollers—was found only in the high-end domain. But as in many Windows packages, the ability to plug in extensions is becoming commonplace. As a result, lower-

priced programs such as Ray Dream Studio ship with SDKs just as more expensive products do.

LOOSE ENDS

Despite the significant strides that have been made during the past couple of years in 3-D software, certain challenges still remain. Specifically, no true interface standardization yet exists among 3-D products. And a lack of 3-D interchange file formats complicates the problem. 3DS, the mesh format of Kinetix's 3D Studio MAX, acts as a de facto standard on the PC. With the release of a Windows SDK for Apple's QuickDraw 3-D (and its 3DMF format) and Microsoft's plans for its own 3-D interchange file format, we should see compatibility improve.

Note that these formats support only mesh, lighting, and shader information; none support animation-path interchange data. One candidate is VRML

(Virtual Reality Modeling Language), most commonly used as a delivery mechanism for 3-D over the Web. (See the article "The Web Goes 3-D" in this issue for more information on VRML creation and browsing.)

HOW WE TESTED

To evaluate these packages, we performed common modeling and animation tasks designed to expose each program's strengths and weaknesses. All the packages ably handled the job of creating a rotating, texture-mapped globe with text revolving around it. And though many could model our bouncing ball and boxes scene, animating our Luxo Jr.-style lamp to follow the motion of the ball proved difficult for some of the low-cost packages.

We also generated a space station (and spaceship with animated flight path) to engage any

special tools we might have missed. Finally, to determine the memory limits of the packages, we repeatedly imported a 170,000-polygon mesh.

Our test-bed consisted of an Intergraph TDZ-410, a dual-processor Pentium Pro/200 system configured with 128MB of RAM. This system was equipped with Intergraph's proprietary RealIZm OpenGL accelerator with 64MB of texture-mapping memory. We also used a variety of 3DS meshes from Viewpoint DataLabs' DataShop 4.0, a CD of models. If this sounds like an overly steroidal test setup, keep in mind that working in 3-D can put a most resource-intensive burden on your PC.

Note also that the packages we look at here are general-purpose tools. But programs designed specifically for quick and easy text extrusion and animation can give you professional results with little fuss (see the sidebar "Marquee Value: 3-D Text and Logos"). Ultimately, wherever you choose to venture—into the realm of the flying logo or the arcade-game asylum—you'll definitely find plenty of options on your 3-D horizon.

Macromedia Inc.

Extreme 3D

Ideally, 3-D software should be both powerful and easy to use, but practically speaking, most products must sacrifice one to achieve the other. Then there's Macromedia's Extreme 3D 1.0 (\$699), which is neither as powerful nor as easy to use as its competitors. It does, though, offer such virtues as network-distributed rendering and cross-platform compatibility.

Extreme 3D is a Phong-shading, spline-based program that runs on PCs (it's compatible with Microsoft Windows 3.x, Windows 95, and Windows NT) and Macs. Though its wizard-based installation was a relatively easy procedure, we saw a disconcerting message pop up at the end warning us that parts of the interactive tutorial may not run correctly under Windows NT. The product ran smoothly after we downloaded and applied an upgrade patch from Macromedia's Web site.

The opening view is the workspace, a small window with a gridded working plane that gives you a direct 2-D view of the 3-D world. You can drag the 2-D work

COMING TO TERMS WITH 3-D

Animation path An editable line that objects follow during the course of an animation.

Anti-aliasing Also known as *oversampling*, the process reduces, or smoothes, the stair-stepping visual effect often seen in bitmapped graphics.

Extrusion Taking a flat, 2-D object and adding a z plane to expand it into 3-D space.

Inverse kinematics In an object hierarchy where there are parent and child objects, grabbing one child object at the end of a chain and automatically calculating the proper movements back to the first object, all according to a series of preprogrammed constraints. An example would be an articulated hand, where moving the tip of a finger causes all the other parts to move together in a properly jointed way.

Keyframes User-specified frames that are recorded on an animation time line. The animation application automatically fills in the intermediate action between these frames to create fluid animation.

Lathing Creating a 3-D surface by rotating a 2-D spline around an axis.

Mapping Placing an image on or around an object so that the image is like the object's skin.

Modeling The process of creating free-form 3-D objects.

NURBS (Nonuniform Rational B-Spline) A type of spline that can represent more complex shapes

than a Bezier spline.

Phong shading A computation-intensive rendering technique that produces realistic highlights while smoothing edges between polygons.

Polygon-based modeling Representing 3-D objects as a set or mesh of polygons.

Primitives Basic geometric shapes, such as balls, cubes, cylinders, and donuts (or toruses).

Ray tracing Rendering objects in a scene by following light-ray paths from the observer back to the objects and light sources.

Rendering Producing realistic imagery and animations from 3-D models.

Spline-based modeling Representing 3-D objects as surfaces made up of mathematically derived curves (splines).

Time line A scale measured in either frames or seconds; it provides an editable record of animation events in time and in sequence.

Tweening Also known as *in-betweening*; calculating the intermediate frames between two keyframes to simulate smooth motion.

x, y, z planes The three dimensions of space; each is designated by an axis. The x- and y-axes are the 2-D coordinates, at right angles to each other. The z-axis adds the third dimension.



Editors' Choice

- Entry-level: Ray Dream Studio
- Professional: 3D Studio MAX



3-D professionals are more likely to be able to pay thousands of dollars and manage the learning curve to use tools like our professional-level Editors' Choice, Kinetix's 3D Studio MAX. This product offers a near-perfect union of power and integration into

the Windows NT operating system. For those with more modest budgets, Fractal Design's Ray Dream Studio 4.1 blends affordability, relative ease of use, and effective hand-holding—without skimping on power—to make it our entry-level Editors' Choice.

For under \$500, Ray Dream Studio offers many but not all of the same tools that you'll find in 3D Studio MAX. What's more, it has one of the best ray-tracing rendering engines available today.

Fractal Design has smartly created a handfull of simple wizards (including prebuilt objects) that take 3-D neophytes through some of the more basic 3-D tasks, including the design of 3-D logos and basic scenes. Unlike many of its competitors and all of the high-end tools, Ray Dream eschews the four-pane work area in favor of three walls with 3-D projections. This approach works remarkably well. Ray Dream also features a broad range of output abilities, including Adobe Photoshop's .PSD file format and VRML output.

Ray Dream's nearest competitor, Caligari's trueSpace 2, deserves an honorable mention here. The original version of trueSpace, a recipient of a *PC Magazine* Technical Excellence award, was the first to stake out the entry-level 3-D arena. Even now the present version offers some abilities, such as Booleans, still un-



matched by Ray Dream. But trueSpace 2 lacks inverse kinematics, and without any Wizards, it is harder to use than Ray Dream.

At the high end of the spectrum, 3D Studio MAX goes beyond the expected collection of primitives, model deformation, free-form modeling, and animation tools and offers powerful animation tools such as particle systems (with a gravity option) for snow and rain, a highly useful modifier stack, and extensive controls over inverse kinematics. 3D Studio MAX's unusual interface does not fly in the face of Windows convention but instead offers a unique way to access a tremendous amount of functionality. More than two-thirds of the settings and controls are accessible via the tabbed interface. The real-time shading engine (known as Heidi) is fast and powerful, and the rendering tools are adept. One caveat, though: 3D Studio lacks ray tracing, so reflections have to be fudged through reflection image maps.

Microsoft's Softimage earns an honorable mention for professional-level use. It costs more than twice as much as 3D Studio MAX but offers a far more powerful engine. Softimage also builds in many of the third-party plug-ins that 3D Studio users must buy separately. But beware: The interface in this second Windows version is markedly nonstandard, a surprising deviation from Microsoft's norm.



surface to resize the grid, and Windows Setup lets you set the pixel size of the window. Most users will probably select the four-panel view option, which can be customized for top, three-quarters, left, right, or other perspectives at various magnifications and models (bounding box, wireframe, and screen render, for example). You can apply a zoom tool to an entire window or a selected area, and you set the

degree of magnification or reduction by typing in a numerical value.

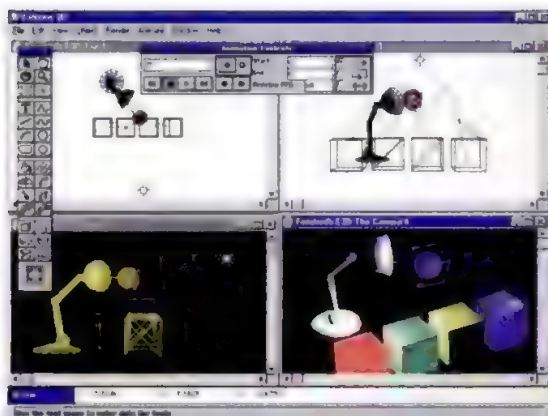
Though Extreme 3D doesn't support NURBS or metaballs, we had no difficulty creating simple objects and surfaces and joining them together in complex configurations with construction points and linking tools. The program offers only a handful of extrusion and beveling options, but these work fast and well. The

skin, lathe, sweep, and surface tools let you quickly create intricate 3-D landscapes and objects, which you can easily deform after simplifying the geometry. The program lacks inverse kinematics and dynamics, however, so it offers no automated deformations, such as the squashing of a ball when it bounces. Extreme 3D's lack of right-button mouse support also makes moving, rotating, and scaling objects inconvenient.

Animation is time- and frame-based; you can display and edit a path just like any spline curve. One of its better animation features is the auto-rotate command, which can be used to turn any object on its

Our Contributors: YVONNE KOULOUTHROS is a staff editor at *PC Magazine*. DANIEL GROTTA and SALLY WIENER GROTTA are contributing editors of and LORI GRUNIN is a frequent contributor to *PC Magazine*. ROB GLIDDEN and DANIEL B. LEVINE are freelance writers. DAN SMITH was the associate project leader in charge of this story, and LANCE N. ULANOFF was the senior associate editor.

3-D Animation Software



As shown in this four-panel option, Extreme 3D provides flexible-view setups from wireframe to shader.

x-, y-, or z-axis for a specific number of degrees over a set number of frames.

Customizing and animating lights and cameras follow the same keyframe-definition process as any other object animation. And having a light stay on a specific object is an easy click-and-drag watch link. Moving the camera interactively and precisely in the workspace is difficult, though.

Applying textures to objects appears logical and therefore simple, but in practice the process could frustrate you. Besides the nine basic and highly customizable shaders, Macromedia includes a CD with hundreds of textures, environments, and bump maps. But the program doesn't supply an easily accessible visual catalog or use descriptive filenames, so selecting

the appropriate texture, for example, is a time-consuming matter of trial and error.

Extreme 3D's Phong-rendering engine is both versatile and fast. Though it doesn't support field rendering, it does include network rendering at no extra cost. Rendered objects appear colorful, detailed, and—depending on your settings—realistic. Extreme 3D lacks direct support for VRML (a downloadable converter is available, however).

Extreme 3D is marketed both as a standalone application and as part of two suites (FreeHand Graphics Studio, \$995; and Director Multimedia Studio, \$1,495). And Extreme 3D's proprietary formats can be read on both the Mac and PC.

The present version of Extreme 3D, a solid if somewhat unspectacular performer, basically needs an upgrade to improve its power and ease of use.—*Daniel Grotta and Sally Wiener Grotta*

SUITABILITY TO TASK

Extreme 3D

	Power	Ease
Modeling	Fair	Good
Rendering	Fair	Good
Animation	Fair	Fair
Scene composition	Good	Good

Extreme 3D 1.0. List price: \$699. Requires: 486-based PC or better, 16MB RAM, 20MB hard disk space, Microsoft Windows 3.x or later. Macromedia Inc., San Francisco; 800-470-7211, 415-252-2000; fax, 415-626-0554; www.macromedia.com. Circle 509 on reader service card.

NewTek Inc.

LightWave 3D

For years, professional animators have used LightWave 3D to generate high-quality flying logos and alien creatures. We salute their ingenuity and persistence. Though this \$1,495 package offers many of the tools we consider essential for commercial or artistic work, it lacks basic features (such as grouping tools) that would make 3-D work a lot easier.

LightWave 3D 5.0 consists of two applications: Modeler and Layout. As you'd expect, you create your models in the former and arrange and animate your scenes in the latter. You export models back and forth between the two—and you must remember to Save All Objects in Layout, a separate dialog and function from Save Scene, or you'll lose many changes (as we did initially).

This bifurcation of tasks wouldn't be so bad if there were more interface consistency between the two. For instance, Modeler offers four simultaneous viewpoints; Layout allows you only one at a

3-D ANIMATION SOFTWARE

How to Read the Suitability to Task Boxes

Until recently, professional-level 3-D animation work was the sole province of SGI graphic workstations. Now, a 200-MHz Pentium Pro-based Windows NT system can serve as your 3-D workhorse. But while 3-D power has arrived on the Intel platform, vendors are just beginning to address ease of use. For example, no standard Windows interface exists among these products. These products still have a way to go, but they will produce eye-pleasing results even now.

For our **modeling** task, we look for features such as polygon- and/or spline-based modeling—applying magnets, smoothing, and building organic shapes—and surface modeling, which includes the use of patches, splines, and NURBS. Primitives are a must. We also look at the range of polygon

reduction features and the intuitiveness of the user interface

SUITABILITY TO TASK

Product name

	Power	Ease
Modeling	Excellent	Excellent
Rendering	Good	Good
Animation	Fair	Fair
Scene composition	Poor	Poor

For our **rendering** task, we look for a range of shading and texture options: the ability to preview shaders with different settings and the ability to preview a scene in a lower-quality render is especially important here. Other output formats, such as .AVI,

.FLC, and VRML, are included in this task.

For our **animation** task, we consider the quality of time-line editing tools, path-based and keyframe animation, plus support for inverse kinematics and the ability to program expressions, relations, or functions. We examine object morphing and look for advanced functions like gravity simulation and collision detection.

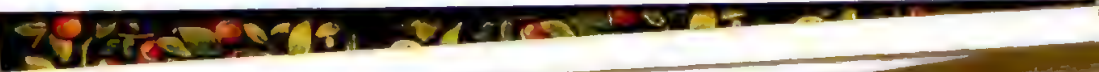
For our **scene composition** task, we look for sufficient object and scene control tools to allow you to build an entire scene. We also examine import filters—such as .DXF, line art, and 3DS—and evaluate a package's ability to autotrace or extrude bitmaps and line art.

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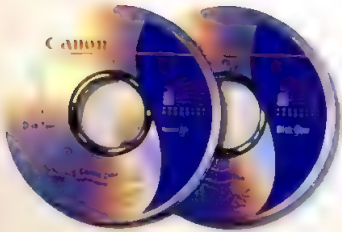


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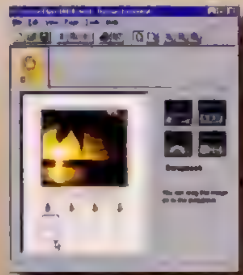
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HOW ABOUT THEM APPLES?

By Rob Glidden

No two applications evaluated here produce 3-D imagery and animation in the same way. As a result, it's almost impossible to compare render speeds or rendering quality. What follows instead is a brief look at some of the rendering styles and technologies that these applications use.

The fastest and lowest-quality rendering is called *interactive* or *real-time* rendering. Interactive rendering is the fast display for editing modes and comes in several flavors: wireframe, flat-shaded, and Gouraud-shaded. 3-D graphics accelerator boards speed up interactive render-

ing (OpenGL, Direct3D, 3DR) but not the final production rendering described below, which is CPU-bound. For final output, you have to use a package's production renderer.

If your task is to create a single still image, a ray tracer is probably the renderer of choice. To get the basic idea of ray tracing, think of tracing a ray of light backwards from your eye to a pixel on the screen and into the 3-D scene, bouncing it back from objects until it reaches its original light source. Ray tracing excels at reflections (metallic surfaces) and refractions (looking through glass).

Scanline renderers, which render images one vertical scanline at

a time instead of on an object-by-object-basis, are often used for animation sequences. Although some people consider the image quality of a scanline renderer to be inferior to that of a ray tracer, a good scanline renderer will be several times faster than a ray tracer.

In practice, the line between ray tracing and scanline rendering can be fuzzy. An intelligent ray tracer may speed itself up by avoiding some calculations, while a scanline renderer will support reflections and refractions through special texture maps or may add ray-traced shadows.

Procedural shaders are essential in ray tracers and scanline renderers.

What you want is some level of procedural shader capability that allows you to tinker with various settings. Advanced features include bump mapping and displacement mapping (both use a texture map as the source to modify the height of an object's surface in addition to its color).

So what's the best renderer? That remains a subjective decision. At the high end, Softimage's Mental Ray (a ray tracer) is often cited, with 3D Studio MAX's scanline renderer given high marks for overall balance of speed and quality. LightWave 3D is known for broadcast-quality rendering and is famous for its use on science-fiction TV programs.



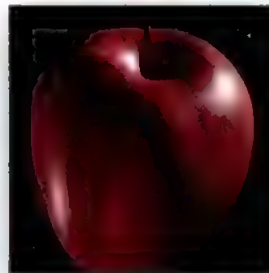
Extreme 3D
Scanline, Phong Shader



LightWave 3D
Ray trace, shadow map



Ray Dream Studio
Ray trace



SoftFX
Phong shader



Softimage 3D
Ray trace



trueSpace 2
Scanline, ray trace



3D Studio MAX
Scanline, progressive



Visual Reality
Scanline

time. Modeler has Undo, Layout doesn't. You can set an object's pivot point visually and numerically within Layout but only numerically within Modeler. One interface feature they do share is the large, immovable dialog boxes that pop up right smack in the middle of the screen.

You can create the same objects in Modeler that you can with 3D Studio MAX or Softimage, but it just takes some extra creativity. Take, for instance, creat-

ing our cartoon hand. Our preferred method is to drag out the points or patches from a NURBS-patched sphere. While LightWave doesn't directly support NURBS-patch creation, its MetaNURBS tool can convert any four-vertex polygon into a NURBS patch and back on the fly (no other product does this).

We discovered that many LightWave users generate NURBS-patch spheres by starting with a cube, metaforming it at

least twice (we had to do this multiple times to gain a sufficiently granular arrangement of polygons), and then toggling on MetaNURBS.

Creating a motion path for our bouncing ball entailed similar contortions. You can't draw paths in Layout, though you can edit their function curves once they are keyframed. But we couldn't just draw a random path without referring to the location of the boxes. We eventually ended

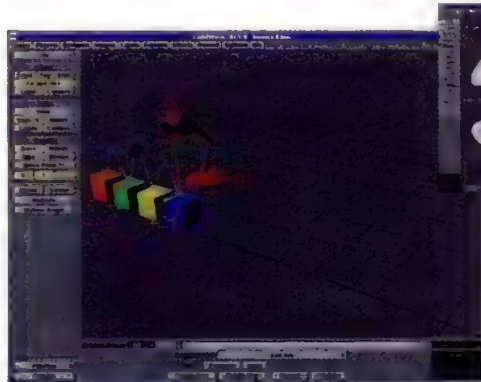
SOFTWARE

3-D Animation Software

up pulling all four box models into a background layer in Modeler, drawing the path in the foreground, and exporting it back to Layout.

Unfortunately, neither Modeler nor Layout let you easily edit your curve tangents, which made fine-tuning our path difficult. Modeler has spline controls, but in Layout you can specify only the tension, continuity, and bias parameters.

The most frustrating aspect of Modeler, however, has to be its lack of any grouping or named selection set tools. To create our lamp, we had to place every segment on a separate layer and export each one as a separate object so that we would be able to animate them later.



LightWave 3D consists of two modules: Modeler (right), in which you build objects, and Layout (left), in which you build scenes and animations. Layout offers multiple viewports, but you can see only one at a time.

TOO CONFINING

LightWave's inverse kinematics tools are far less flexible than either Softimage's or 3D Studio MAX's.

LightWave lets you constrain only rotation angles, not location or translation. Nor does LightWave provide any easy scenewide way to manage your links and parent-child relationships; all this takes place on an object-by-object basis. On the other hand, it comes with the ability to create muscle bulges built-in; in 3D Studio MAX, this capability comes only with the \$995 Character Studio plug-in.

We did like LightWave's renderer, which has a nice selection of controls, tex-

SUMMARY OF FEATURES

3-D Animation Software

Continues

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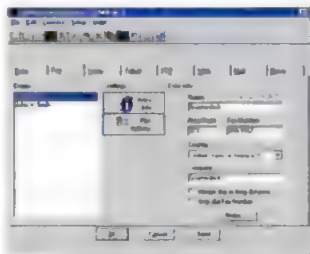
		ENTRY-LEVEL				PROFESSIONAL-LEVEL			
■ YES ■ NO									
Products listed in alphabetical order by category		Extreme 3D	Ray Dream Studio	SoftFX	trueSpace 2	Visual Reality	LightWave 3D	Softimage 3D	3D Studio MAX
List price		\$699	\$499	\$395	\$795	\$258	\$1,495	\$7,995	\$3,495
Modeling									
Primitives:									
Cone/Cube		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Cylinder/Plane		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Sphere/Text object		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Torus		■	■	■	■	■	■	■	■
Surfaces:									
B-spline/Bezier patches		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
NURBS		■	■	■	■	■	■	■	■
Polygon meshes		■	■	■	■	■	■	■	■
Lines:									
Polyline		■	■	■	■	■	■	■	■
Bezier spline		■	■	■	■	■	■	■	■
Object creation:									
Extrude/Extrude along path		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lathe/Loft		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Metaballs		■	■	■	■	■	■	■	■
Object manipulation:									
Bend/Boolean		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lattice deformation		■	■	■	■	■	■	■	■
Taper/Twist		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Modification history maintained:									
For each object/For entire scene		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Polygon reduction		■	■	■	■	■	■	■	■
Animation									
Time-line window		■	■	■	■	■	■	■	■
Function-curve editing		■	■	■	■	■	■	■	■
Expressions and functions		■	■	■	■	■	■	■	■
Inverse kinematics		■	■	■	■	■	■	■	■
Dynamics		■	■	■	■	■	■	■	■
Rendering									
Alpha-channel controls		■	■	■	■	■	■	■	■
Anti-aliasing		■	■	■	■	■	■	■	■
Bump/reflection maps		■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

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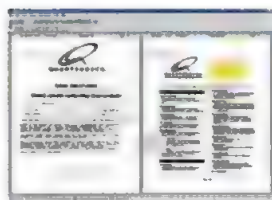
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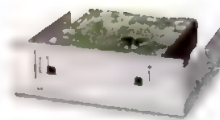
software

STAPLES

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3-D Animation Software

tures, and output quality choices. It lets you generate several variants and preview them before you choose the one you want to apply.

NewTek has equipped LightWave with some obvious strengths. Unlike Kinetix (maker of 3D Studio MAX), for example, NewTek offers separate boxed versions of LightWave for several different platforms, and a large variety of

plug-ins are available as well. LightWave also requires less horsepower to run than either 3D Studio MAX or Softimage. And LightWave has the advantage of being the least expensive of the packages with professional capabilities. So if you're really strapped for cash, you'll still be able to get the job done with LightWave; it will simply take a little more brainpower.—LG

LightWave 3D 5.0. List price: \$1,495. Requires: 486-based PC or better, 16MB RAM, 50MB hard disk space, Microsoft Windows NT 3.51 or later. NewTek Inc., Topeka, KS; 800-862-7837, 913-228-8000; fax, 913-228-8099; www.newtek.com. *Circle 510 on reader service card.*

Fractal Design Corp.

Ray Dream Studio



Ray Dream Studio 4.1 earns a mark of distinction: Though remarkably powerful, this \$499 product from Fractal Design Corp. is nonetheless a comparatively easy-to-use, cross-platform 3-D animation package.

The only application here to offer wizards for creating scenes and 3-D logos, Ray Dream takes on the complex task of creating highly rendered 3-D imagery and animation and makes it accessible.

Three-dimensional rendering, modeling, and animation are complicated issues.

SUITABILITY TO TASK

LightWave 3D

	Power	Ease
Modeling	Good	Good
Rendering	Good	Good
Animation	Good	Good
Scene composition	Good	Good

SUMMARY OF FEATURES

3-D Animation Software

PC MAGAZINE
EDITORS' CHOICE

PC MAGAZINE
EDITORS' CHOICE

ENTRY-LEVEL

PROFESSIONAL-LEVEL

■ YES ■ NO

Products listed in alphabetical order by category

Rendering (continued)

	Extreme 3D	Ray Dream Studio	SoftFX	trueSpace 2	Visual Reality	LightWave 3D	Softimage 3D	3D Studio MAX
Displacement mapping	■	■	■	■	■	■	■	■
Field rendering	■	■	■	■	■	■	■	■
Fog	■	■	■	■	■	■	■	■
Gamma correction	■	■	■	■	■	■	■	■
Layered/procedural textures	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Lens flare	■	■	■	■	■	■	■	■
Motion blur	■	■	■	■	■	■	■	■
Network rendering	■	■	■	■	■	■	■	■
Shader language	■	■	■	■	■	■	■	■
Shadows	■	■	■	■	■	■	■	■
Supported render types	Phong, Scanline	Draft Z-Buffer, Production Z-Buffer, Ray Trace	Hidden Wire, Phong, Wire-frame	Ray Trace, Scanline	Scanline	Ray Trace, Shadow Map	Ray Trace	Progressive, Scanline

Interactive Viewing

Shaded	■	■	■	■	■	■	■	■
Texture-mapped	■	■	■	■	■	■	■	■
Supported 3-D display acceleration APIs	None	Direct3D	OpenGL	3DR	None	OpenGL	OpenGL	Heidi

File Handling

Supported 3-D file types (import and export):								
ASC/DXF	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
3DS/VRML	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Supported 2-D file types (import and export):								
.BMP/GIF	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
TIFF	■	■	■	■	■	■	■	■
TrueType/PostScript	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

Libraries

Models	25	500	123	600	730	300	274	120
Textures	300	350	50	200	1,700	150	230	1,268
Materials/Shaders	300.9	350.0	50.23	150.0	400.0	100.30	122.96	1,268.14
Supports plug-ins	■	■	■	■	■	■	■	■
Output:								
AVI	■	■	■	■	■	■	■	■
FLC	■	■	■	■	■	■	■	■

(1) At modeling time. (2) Import only. (3) Export only.

MARQUEE VALUE: 3-D TEXT AND LOGOS

By Rob Glidden

For under \$250, the following products can help you create an attractive 3-D logo in almost no time at all. But note that the once-popular Typestry has been discontinued by its maker Pixar, whose 3-D film *Toy Story* has led it to seek its 3-D fortune in Hollywood filmmaking.



Flying Fonts Pro 3.02, \$245 (list price) from CrystalGraphics (800-394-0700, 408-496-6175), is designed to let you quickly create those majestically dramatic flying logo clips you see on TV, the kind where larger-than-life metallic 3-D letters move along orderly paths. Although you can actually create a broadcast-quality logo clip with this Windows app, Flying Fonts Pro is really best suited for creating a professional-looking stock logo clip for something to use on your next multimedia presentation or Web site.



AddDepth 1.1, \$99 (list price) from Fractal Design Corp. (800-846-0111, 408-430-4000; www.fractal.com), takes quite a different tack on the idea of 3-D text. AddDepth is a 3-D vector drawing tool, which means you use it to create 3-D-looking draw-format output, like that of Adobe Illustrator, FreeHand, WMF, EPS, or CGM. It does not render a final image like its competitor, Flying Fonts Pro, does—or, for that matter, like the 3-D modeling and animation packages reviewed here.

Each application examined here addresses these issues in its own way, and Ray Dream is no exception. Fractal's answer to the riddle of how to work with 3-D objects in the PC's 1-D plane is to offer a three-walled workspace representing *x*, *y*, and *z* planes. As you move an object in space, a projection of that object appears on all three walls. To move an object up in the *z* plane, you simply grab the projection of the object on the wall. This approach sets Ray Dream apart from products that rely solely on multiple views to help you position objects, although Ray Dream also lets you open multiple views—top, bottom, and sides. The only problem with this metaphor is that you can sometimes move an object outside the range of these walls.

This spline-based, ray-tracing applica-

tion features the usual collection of primitives and even adds an octagonal object. You can pretty much draw any object you need using the spline-based drawing tools, which come complete with draggable anchor points to distort and shape lines. Ray Dream also provides a flat drawing plane to make this task even easier. Once you've drawn your shape, the application automatically extrudes it. You can then use the perspective view to control the depth of extrusion, lathe an object, or apply boilerplate torus and spiral extrusions, to name just a few options. Unlike Caligari Corp.'s polygon-based trueSpace 2, Ray Dream doesn't let you create lattice deformations by grabbing vertices on a 3-D object and dragging in or out. Instead, you deform objects by previewing them through the deformation settings on the tabbed properties box.

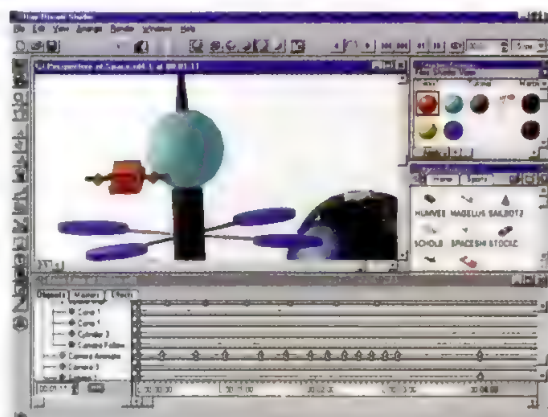
Every object—including lights and cameras—exists as a nameable object in

the object hierarchy window. You can view this as an iconic object, or by name with the time line alongside it. Each object (and every aspect of each object) can have its own time-line entry and actions.

Ray Dream is a keyframe-style animation tool. You can't create animations by drawing a path, but you can view the animation path of any object—especially useful for applying tweening operations to the motion path of our bouncing ball. You play back all animations in real time or output quick, savable animation previews that include the backgrounds not viewable in the working scene.

Despite its sub-\$500 price, Ray Dream remains a powerful product with a sizable number of high-end controls. You set inverse kinematics by simply selecting a property of a given object. Wrapping textures around objects and projecting them onto surfaces works nicely, and because you can work interactively in various levels of rendering quality, you can often see the results of your handiwork right away.

Other tools for fine-tuning your image include the shader window, from which you can drag and drop any prebuilt shade (marble, wood, or glass) or texture map, and an objects browser window, which comes with many prebuilt objects that you can add to your scene and modify. You can also drag and drop your own objects into this browser for later use. The shades are editable, and you can drag and drop



Ray Dream's interface is user-configurable. If you like the position of your time line, shader, and object browser, you can save it as a named interface and reload it at any time.

customized shades to the shader window.

Ray Dream's extensive output options run the gamut from simple .BMPs to rendered .AVIs. There are even Geometry

SUITABILITY TO TASK

Ray Dream Studio

	Power	Ease
Modeling	Good	Excellent
Rendering	Good	Excellent
Animation	Good	Excellent
Scene composition	Excellent	Excellent

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R185F

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- Telephone Answering Device & Speakerphone
- 16-bit SRS3D Wavetable Audio
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M162D83C

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3-D THAT WORKS THE WAY YOU DO

By Rob Glidden

For some people, 3-D is a medium unto itself. But for others, 3-D is just another data type to incorporate into existing work environments. TriSpectives Professional and Instant 3-D reflect the latter view by integrating into Microsoft Windows 95, Microsoft Office, and OLE environments. Neither package had the feature mix to qualify for our main roundup, but each is impressive in its own way.

TriSpectives Professional 1.0, \$500 (street price) from 3D/EYE Inc. (770-937-9000; www.eye.com), is a truly ambitious and ground-breaking product. It's the first 3-D package to attempt spanning both the 3-D graphic design and CAD markets. The heart of TriSpectives is the ACIS solid-modeling engine from Spatial Technology. ACIS is the kernel in many CAD packages, including AutoCAD.

A key feature of TriSpectives is IntelliShapes, the product's implementation of ACIS solid-model shapes. If you're mod-

eling human-designed objects (say, a phone or a piece of furniture), IntelliShapes will work very well once you get the hang of using them.

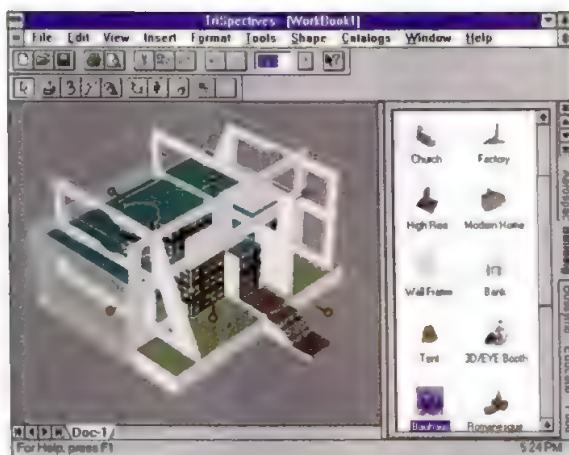
TriSpectives' strength lies in the depth and breadth of its feature set. Also, you can drag and drop TriSpectives models as OLE objects into any OLE-enabled container application. Its limitations

lie primarily in animation.

Instant 3D 1.2, \$50 (street price) from Micrografx Inc. (800-669-7318, 214-234-1769; www.micrografx.com), was originally intended to be a Windows 95/OLE-compatible replacement for its low-end 3-D modeling and animation product, Simply 3D, but the feature sets and user inter-

faces ended up being different enough for the company to leave both of these low-end packages on the market. Micrografx expects to release yet another low-end 3D package soon.

If you're seeking an entry-level Office 95-compatible 3-D package, Instant 3D fills the bill. It's easy and even fun to use, and you can achieve some impressive results with very little effort. Do not expect a full-fledged modeling package, though; this is simply a 3-D layout-composition tool that you may quickly outgrow. Instant 3D is mainly for creating simple 3-D logo images that you can embed as OLE objects in OLE-compatible applications such as Microsoft Word.



TriSpectives excels at building architectural and product designs.

buffers for channel operations in Adobe PhotoShop and VRML output.

Fractal's attempts to make this application more accessible via wizards and an intuitive drag-and-drop interface fall short in a few key areas. The manual is not well indexed, and it often fails to explain how some complex functions will affect your animation. And if your confusion leads you a few steps too far in your project, don't expect Ray Dream's one-level undo function to help you find your way out.

Despite these minor frustrations, Ray Dream emerges as an affordable, well-crafted product—and one of the few in this roundup to evidence a clear understanding of the Windows environment by offering drag-and-drop, customizable tool bars, multiple-scene windows, and right-button mouse support. With such a good start, the future looks bright for Ray Dream Studio—and the intrepid 3-D artists who choose to use it.—*Lance N. Ulanoff*

Ray Dream Studio 4.1. List price: \$499. Requires: 486-based PC or better, 12MB RAM, 40MB hard disk space, Microsoft Windows 3.1 or later. Fractal Design

Corp., Scotts Valley, CA; 800-846-0111, 408-430-4000; www.fractal.com. **Circle 511 on reader service card.**

Byte by Byte Corp.

SoftF/X

SoftF/X 2.5 (\$395 list) arrives as a very thin package, consisting only of a CD and no printed documentation. Unless you are prepared to shell out an extra \$60, a lengthy Acrobat file serves as your only source of information.

As a result, when the program installs various icons onto the desktop, an unsophisticated user unfamiliar with modular-type 3-D software may not know which icon to click on first. What's more, SoftF/X lacks a quick-start tip sheet, a short overview tutorial, and a search engine in the Help menu.

Fortunately, though, SoftF/X's organization is straightforward. It consists of two separate but nicely integrated programs: Modeler and Animator. Even after you place an object into a scene in Animator, you may return it to Modeler using a pull-down menu, edit it, and put

it back into place in Animator with another simple mouse click. And you can do this without losing the motion, position, morphing, or other information previously attached to the object by Animator.

Modeler includes toolboxes of Tools, Actions, and Select palettes. But SoftF/X hides primitive shapes in a dialog box that pops up when you choose Build Primitives in the Edit pull-down menu. The PostScript extrusion utility has few options; for example, there's only one type of bevel. But once you've modeled text, you can export it to Animator as a single object or as individual letters that fit neatly and automatically to any preset or customized path. This let us quickly and easily create a nicely curved *hello* encircling a globe.

We experienced difficulties using models from other programs. Actually, SoftF/X won't open or import anything that isn't in its proprietary format (SCE). And though Modeler includes a conversion utility for .DXF, .SCN, .TDD, and .3DS file formats, we had mixed results using it. Some 3DS clip art converted

flawlessly; other clip art failed. And we were unable to convert one of our test images, a complex .DXF picture.

In Modeler, you can also apply textures and materials to objects, as well as knit objects together into posable skeletons. Textures, images, shaders, and other material builders are customizable (though not extensively), and they let you directly and interactively fit image maps to objects.

Building the hierarchically linked skeletons in SoftF/X is another matter entirely. Because objects are defined by their vertices, hierarchical relationships require meticulous selection and manipulation of those tiny points. In addition, the hierarchically linked connections are also based on vertices and must be fitted exactly along the defining points of the interrelated objects. This can be a time-consuming task that leaves no room for error. When the object is finally defined properly, you can create different poses for the object that can be imported into Animator, which can then morph the poses to each other. You can also pose them in Animator using the Keyframer time line, but you probably won't have the same kind of control as you did with the morphs.

Animator's Keyframer time line provides superb control over all actors in the scene. (An *actor* is anything that's placed into the animation or scene, including objects, lights, paths, and so on.) Each actor has four time lines: position, rotation, *costume* (the object used to define the actor for that moment in the time line), and size. Since all actors' time lines are displayed in the same window, it's easy to correlate even complex actions among various elements. Double-click on any keyframe within a time line and a dialog pops up with some sophisticated options.

Still-image output under SoftF/X is quite remarkable—when you use the right combination of settings. We were disappointed, however, in the quality of SoftF/X's high-resolution renders of

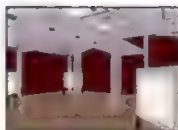
TWO 3-D TOOLS GO ONE STEP FURTHER



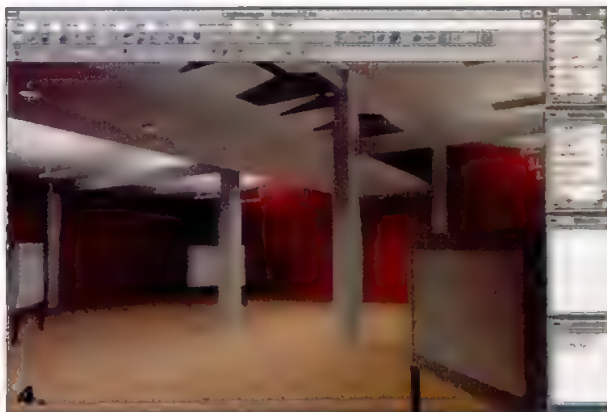
1.



2.



3.



By Yvonne Koulouthros

Most 3-D renderers offer some lighting abilities. But none of these compares with the diffuse lighting effects found in Lightscape Visualization System (LVS). Manufactured by Lightscape Technologies (408-342-1900; www.lightscape.com), LVS (\$2,995 list) uses a unique technology called *radiosity*, which calculates the distribution of light energy among the surfaces of 3-D models. LVS also imports .DXF structures, lets you export into VRML, and supports formats such as .BMP, .GIF, and TIFF.

You start by piecing together the components of a building, such as the walls and structures (Figure 1). As you add more pieces (ceiling, floor, and so on), you can work in a wireframe (Figure 2)

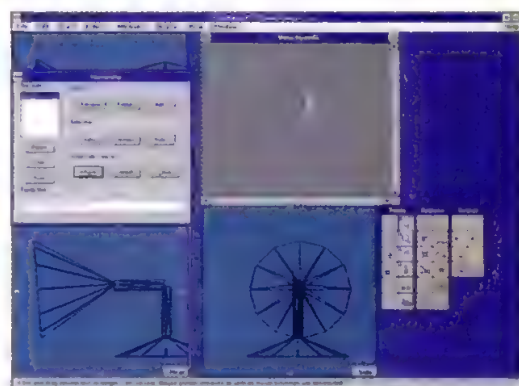
or a shaded view. When you've finished adding colors and textures (Figure 3), you choose your luminaire setting. The result is often a rendering so striking, it resembles a high-resolution photo (Figure 4). Note that LVS doesn't animate models and doesn't work as well with outdoor settings. But for indoor scenes, LVS is a designer's dream.

Yet another product offers tools beyond the 3-D-rendering norm. Fractal Design Detailer lets you paint in real time, directly onto the surface of 3-D models from file formats such as .BMP, .JPEG, and the formats used by Adobe Photoshop, and Ray Dream Studio—all with unprecedented ease. Detailer (price to be announced), which should ship by the time you read this, comes from Fractal Design Corp., the makers of Ray Dream Studio.

.AVI-based animation files. Byte by Byte Corp. says it added .AVI support at the last minute, noting that the feature uses an undefined and uncontrollable compression algorithm to output frames. The next version should offer far greater control over .AVI output. .FLC file renders look much smoother, though they too are compressed to some extent and do show a bit of color posterization and sawtooth aliasing.

Overall, SoftF/X does have strengths, like its Keyframer time line, generally seen in high-end programs. But it ultimately doesn't measure up to the latest entry-level 3-D software.—*DG and SWG*

SoftF/X 2.5. List price: \$395. Requires: 386-based PC (with math coprocessor) or better, 8MB RAM, 40MB hard disk space,



Establishing parent-child hierarchies in SoftF/X is a meticulous process, involving precise vertex selection. But it does create flexible hierarchically linked objects.

Microsoft Windows 3.1 (with Win32s) or later. Byte by Byte Corp., Austin, TX; 512-305-0360; fax, 512-305-0371; www.bytebybyte.com. Circle 512 on reader service card.

SUITABILITY TO TASK

SoftF/X

	Power	Ease
Modeling	Fair	Good
Rendering	Fair	Good
Animation	Good	Excellent
Scene composition	Fair	Good

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CIRCLE 392 ON READER SERVICE CARD

3-D Animation Software

Microsoft Corp.

Softimage 3D

With a bottomless pit full of features, Softimage 3D 3.51 emerges as the most powerful modeling and animation product currently available on the PC. It's easier to use than you may think, but its interface betrays its Unix roots. And unless you work in teams or need rocket-science levels of control over patches and curves, you'll find Softimage 3D's power and \$7,995 entry-level price tag (not to mention its steroidal hardware requirements) to be overkill.

Though the interface takes a bit of time for the Windows denizen to get used to, dexterous animators will find its combination of shortcut keys (called Supra keys), menus, and mouse operations a zippy way to get the job done. Unlike LightWave 3D, Softimage provides guidance and feedback on the status bar, which makes an immense difference.

DIVIDE AND CONQUER

The program consists of five modules—Model, Motion, Actor, Matter, and Tools—but this schema works no less efficiently than 3D Studio MAX's glitzier one. For example, we used the same method in Softimage as in 3D Studio MAX to generate boxes for our bouncing ball animation: We created a cube, generated a three-element repeated duplication, and then used Boolean operations to hollow out the end boxes.

We found Boolean operations to be one of Softimage's few weaknesses (relative to both 3D Studio MAX and LightWave). Softimage offers only Union, Intersection, and Difference operators. Because it lacks a Subtract operator, we had to use Difference and then delete all the extraneous objects.

Creating a cartoon hand went quickly. We started with a quadratic NURBS-patched sphere, tagged selected points, and dragged them out to form fingers. Softimage offers a most extensive set of geometry options, including the ability to use, for example, quadratic patches in the U direction and cubic patches in the V.

The area in which we think Softimage deserves its reputation for difficulty is in

its selection tools. For example, in order to model our lampshade, we had to first select the object before we could select Softimage's Tag points. Then, to work on multiple tag points, we had to make sure we were in Tag mode before we could operate on those points. We could toggle back and forth between Tag modes and translation modes by clicking on the Tag button in the lower-right corner of the screen, but it did require repeated toggling between tools. This turned into even more of a hassle as we moved on to bending and twisting, and it became harder to isolate select points. Once we learned the



Despite its overwhelming appearance, once you grasp the logic behind Softimage's interface you can really fly (left). Softimage provides unmatched control over the geometry of an object (right).

method to Softimage's madness, we moved pretty quickly, but we would appreciate simplification here.

ON THE MOVE

Animating scenes in Softimage, on the other hand, is surprisingly easy. Bouncing our ball meant drawing a path and choosing it as the target. We then used the function curve editor to fine-tune the timing between the ball and the flipping lids.

In fact, we found the program's inverse kinematics tools not only the best of the lot but the easiest to navigate and manip-

ulate. We attribute most of its facility to the Schematic view, which provides a structural overview of your scene and hierarchies (in contrast to 3D Studio MAX, which provides an outlinelike view).

The Schematic view is a great tool for debugging inverse kinematics chains. For example, to link all our lamp objects to a skeleton, we simply chose a parent for each object by working our way up the chain. But the Schematic viewport acts like all other viewports: It offers navigation tools that consist of Tracking, Zoom, and other camera-centric activities, so it could use some work in this capacity.

The base package comes with lots of great tools, including the ability to simu-

late gravity and other physical properties, control collisions, deform based on speed (Q-Stretch), and use paint-on texture maps. And in addition to Softimage's

extensive list of available third-party plugins, the program's extensible Channels architecture lets you use almost any device for capturing motion. You could get lost wandering in this sea of gadgets.

LET'S GET EXTREME

If your needs run to the cosmically complex, you can opt for the \$13,995 Softimage 3D Extreme. The extra change buys you the mental-ray-distributed renderer (an even higher-quality ray tracer than the already good built-in one), a variety of particle systems, Meta-Clay (for sculpturelike modeling), and Softimage Live (a utility for optimizing animations).

Behind all of Softimage's power lies a database engine (in both packages), which saves sequential versions of each model, material, and so on. This database, which you can query, is one key to Softimage's strength as a package for teams of

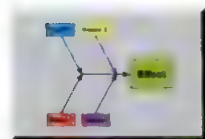
SUITABILITY TO TASK

Softimage 3D

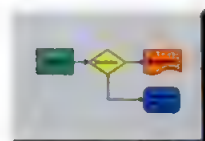
	Power	Ease
Modeling	Excellent	Good
Rendering	Excellent	Good
Animation	Excellent	Excellent
Scene composition	Excellent	Good



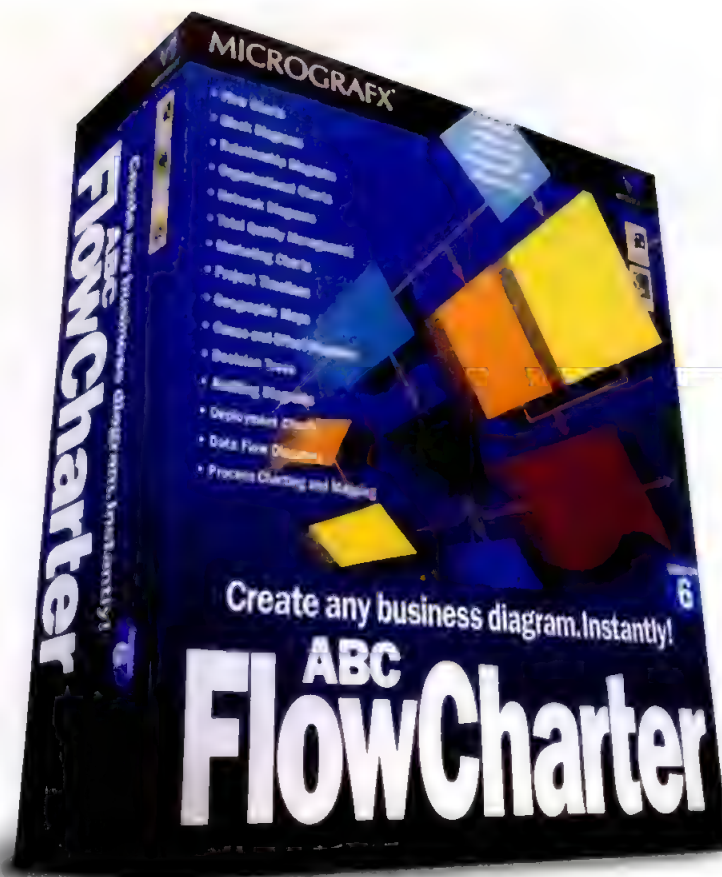
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3-D Animation Software

animators. Managing each project database, though, can be a burden for users who don't need it.

Some jobs require nuclear power, while others can get by with a smoothly running combustion engine. If 3D Studio MAX isn't up to the task when your livelihood depends on it, and if you're willing to spend double its price, Softimage is the program to buy.—LG

Softimage 3D 3.51. List price: \$7,995. Requires: Pentium Alpha or MIPS-based PC or better, 64MB RAM, 1GB hard disk space, Microsoft Windows NT 3.51 with Service Pack 2 or later. Microsoft Corp., Redmond, WA; 800-576-3846, 514-845-1636; fax, 514-845-5676; www.softimage.com. Circle 513 on reader service card.

Kinetix, a division of Autodesk Inc.

3D Studio MAX



It's powerful. It's well designed. It's cheaper than its closest competitor. And it's fun. What more could you ask of a high-end 3-D animation package? Depending on your needs, the answer is either nothing or lots. Kinetix's 3D Studio MAX fronts professional-level modeling and animation tools with an interface that really takes advantage of Windows' conventions, then packs it all into a (relatively) inexpensive \$3,495 package.

Beware of falling into the trap of regarding 3D Studio MAX as a David to Softimage 3D's Goliath. The slingshot lessons that this David needs to bring it up to feature parity with Goliath—in the form of third-party plug-ins—cost money. But on the price/performance scale, we see 3D Studio MAX as a highly scalable product with a lower entry cost, making it a great solution for many animators.

THIS YEAR'S MODELER

3D Studio MAX comes with most of the basics—with the glaring exceptions of NURBS support and a ray-trace renderer—but it really stands out in the way it implements tools. 3D Studio MAX sports both the drop-down menus and icons that Windows users are accustomed to and the programmable shortcut keys that professional animators depend on.

In addition, however, 3D Studio MAX

also surfaces about 80 or 90 percent of its functions on a customizable, sliding panel that occupies the right side of the screen. Through it, you access primitives, modifiers, and hierarchy controls. You perform modeling, layout, and animation in the same screen, and instead of switching modules, you simply pick a tab on the panel with different controls on it.

This panel also contains the modifier stack, Kinetix's most useful contribution to 3-D software design. In essence, the program saves a list of all the parameter changes for every modification you perform. You can go back at any time to any transformation and change it.

Kinetix's plug-ins integrate in a similarly elegant way. We downloaded the free free-form deformation modifier from the company's Web site; after installation, we added it as a button on the modifier panel and it behaved the same way as any built-in modifier.

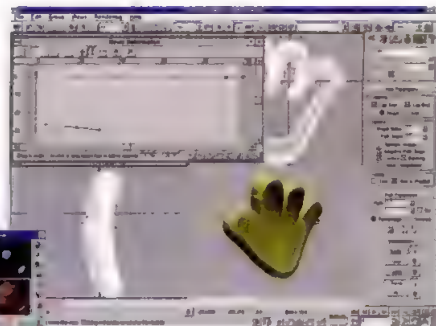
3D Studio MAX contains a wealth of animation tools, including traditional hierarchies and inverse kinematics, function-curve editing, and the ability to change almost anything over time. Keep in mind that mastering the inverse kinematics and other advanced animation controls takes some time; once you've grasped them, however, you have lots of ways to achieve a given effect.

For example, when we were animating our bouncing ball in the lamp-following bouncing-ball test, we chose to simulate the effects of gravity with a Displace space warp (so the ball would squash as it entered the warp's proximity). We could also have created a squashed version of the ball and used morphing. Of course, if 3D Studio MAX let you apply gravity the way Softimage does, we could have accomplished the task in an easier fashion. Unfortunately, you can apply some of 3D Studio MAX's space warps, such as Gravity and Deflect, only to particle systems (for rainfall and explosions, for example).

The product supports both keyframe and path animation, both of which are easy to use. We keyframed the bouncing ball for more precise positioning but assigned our spaceship to a spline path—with bank-ing—for a more free-form flight.

Setting up the inverse kinematics for the

lamp to follow the ball was fairly easy, too. To create an inverse kinematics chain or a standard hierarchical chain, you simply select the parent object, click on the link icon, and drag a connection between that and the child object. You set inheritance and locking parameters for rotation, translation, and scaling on an axis-by-axis basis via



3D Studio MAX's sliding panels (above) allow the package to bring most of its capabilities to the surface. The Materials Editor (at left) provides excellent control over properties.

checkboxes on the hierarchy panel.

Setting up inverse kinematics chains is easier than editing them, however. 3D Studio MAX provides a collapsible outlinelike view from which you can manage almost every aspect of your scene, from materials to hierarchies to function curves. But unlike Softimage's Schematic view, in which you can drag and drop chains from one parent to another, 3D Studio MAX's Hierarchy view forces you to break and re-create chains (unless you simply want to reverse the order of an entire subchain).

RENDER REDUX

If 3D Studio MAX has a weakness, it's the renderer. We found, however, that working interactively in shaded views was sufficiently zippy, thanks to Kinetix's proprietary Heidi display engine.

We also liked the materials editor, which provides a broad, easily accessible array of textures and procedural shaders,

SUITABILITY TO TASK

3D Studio MAX

	Power	Ease
Modeling	Excellent	Excellent
Rendering	Good	Excellent
Animation	Excellent	Excellent
Scene composition	Excellent	Excellent

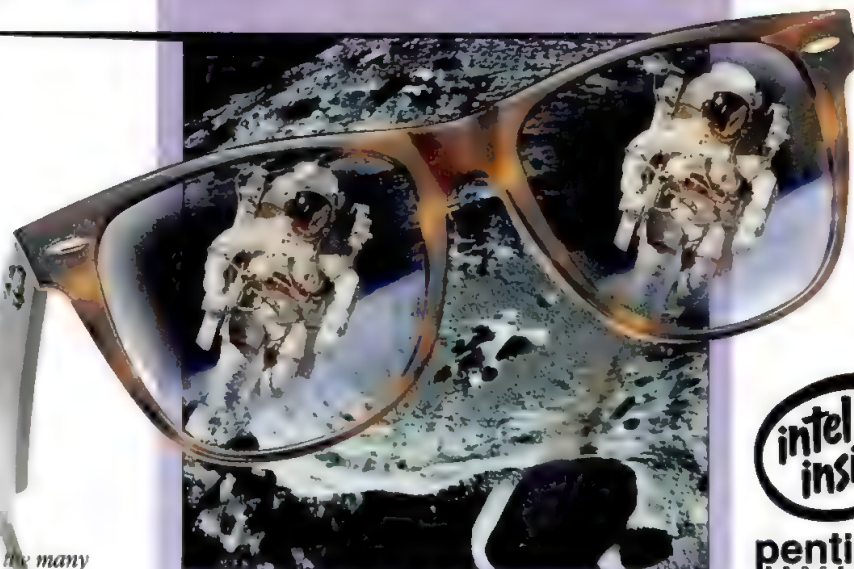
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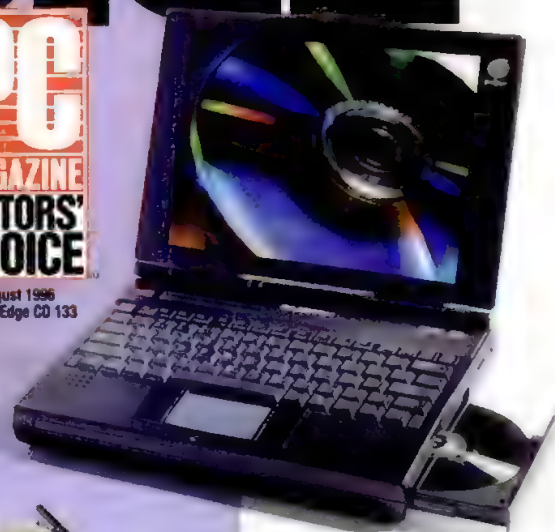
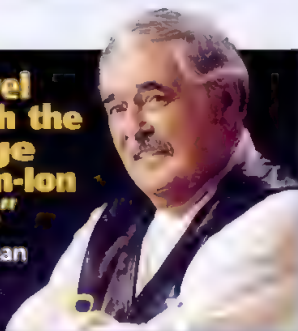
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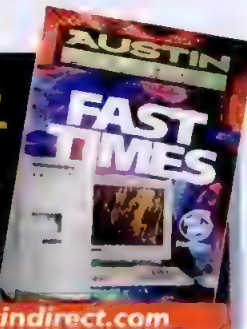
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3-D Animation Software

as well as lighting, mapping, and alpha channel controls. The program offers an adequate range of options for output to both PC graphics and video devices.

But 3D Studio MAX's basic scanline renderer provides substandard quality for a product aimed at the professional market. The product doesn't even offer a basic ray tracer, but we expect to see good plug-in renderers in the near future.

3D Studio MAX makes a great choice for small shops that want to add capabilities as their budgets allow, and supplements the modeling capabilities of programs such as Softimage, which don't have the flexibility of 3D Studio MAX's modifier stack.—*Lori Grunin*

3D Studio MAX. List price: \$3,495. Requires: 90-MHz Pentium-based PC or better, 32MB RAM, 100MB hard disk space, Microsoft Windows 95 or NT 3.51 or later. Kinetix (a division of Autodesk Inc.), San Francisco; 800-879-4233, 415-547-2000; fax, 415-547-2222; www.ktx.com. *Circle 514 on reader service card.*

Caligari Corp.

trueSpace 2

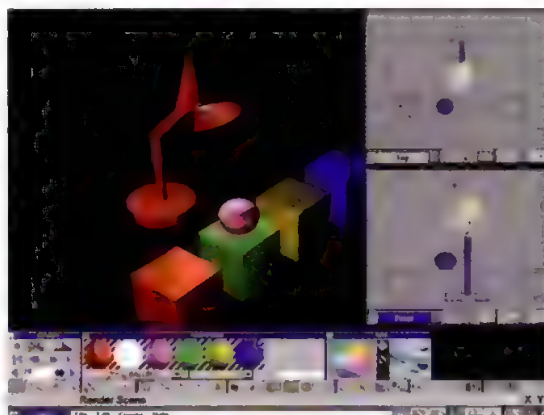
The fact that trueSpace 2 still stands up to and even surpasses more recent applications is testament to Caligari Corp.'s foresight when it shipped the product in June 1995.

At that time, Caligari introduced to the Windows/Intel world features such as solid views and a few Boolean operations—features that we now take for granted in animation packages. Sadly, though, the program hasn't had a major update in quite sometime, and its lack of inverse kinematics and fine-animation control relegates it to the low end of the market. Still, it's a powerful tool for graphic artists, Webmasters, game designers, and multimedia authors, who will find many top-shelf features in this reasonably priced (\$795) product.

In one major respect this product shows its age: It was designed for Windows 3.1 with Win32s, though it runs easily under both Windows 95 and Windows NT (with no long-filename support). As a program designed before the advent of 200-MHz Pentium Pros, however, it does not require immense processing power to run at workable speeds. Artists using at least 486-based machines with 16MB of RAM will

find trueSpace's wireframe views astonishingly responsive. Even its more complex operations are relatively quick.

Effectively working with trueSpace's solid views—which use Intel's 3DR library and show the effects of lighting in real time—requires a more powerful machine, however, and few graphics accelerator makers have chosen to support the Intel API. (An exception is the popular Matrox Millennium, which has shipped with Windows 3.11 3DR drivers since October 1995.) The library is also constantly updated, which will have users running to the Intel Web site for bug fixes and upgrades.



Users can choose the color and intensity of the lights in trueSpace 2 and see the results in real time.

Users running trueSpace for the first time will no doubt find its initial display of nearly 40 icons confusing. The program disregards a number of Microsoft interface conventions, but we began to appreciate its design after a run through the superb tutorial manual. Excellent right-button mouse support, one-touch keyboard commands, a help bar, floating tool panels, and the lack of long, branching, pull-down menus make modeling startlingly fast and intuitive, even when performing complex operations like beveling 2-D paths into 3-D objects.

The controls are efficient but require the user to be fairly familiar with the program before doing almost anything. Also, trueSpace has no preset for instantly ar-

ranging the screen into the traditional "3 orthographic + 1 perspective" layout familiar to users of 3D Studio MAX. But the ability to create small, floating-view windows lets artists easily customize the program's look to their own tastes—or even to the needs of a particular model, which can be set as the default view.

Users control animation either by assigning objects to easily editable paths or by keyframing. Though you can keyframe almost every operation, trueSpace's limited keyframe monitor makes editing complex animations rather laborious. And because the program lacks wizards that can speed up common animation tasks (like those found in products such as Ray Dream Studio), users can't really conjure up a clear-cut strategy.

Caligari Corp. includes a CD with more than 200 textures and 600 model files in its own .OOB format. Users, though, can feel secure using almost any geometry library or file downloaded from the Internet. The program imports enough geometry formats to double easily as a file-conversion utility. The application supports the standard .DXF and ASCII 3D Studio MAX file

formats and adds filters for binary 3DS files, as well as for Imagine, LightWave, and Wavefront geometry. Of course, files import with varying degrees of fidelity; binary 3DS files, for example, lose their hierarchy information. Notably absent (another sign of trueSpace's age) is support for VRML. Caligari produces a low-cost VRML authoring tool called Pioneer, however, which when used with trueSpace makes for a formidable VRML modeling and publishing package.

Rendering takes place inside the program, with no provision for external renderers. But you can render any viewport at any time with many options common to higher-priced products. Right-clicking on a render button brings up a small, render-options floating bar that accesses the ray-tracing engine, fog controls, multiple levels of anti-aliasing, and animated backgrounds. You can render to .AVI, .FLC, and numbered bitmapped files through another dialog that also controls motion blur, depth of field, and the ability to render

SUITABILITY TO TASK

trueSpace 2

	Power	Ease
Modeling	Excellent	Excellent
Rendering	Excellent	Excellent
Animation	Good	Fair
Scene composition	Excellent	Good

3-D Animation Software

multiple fields for output to video.

The product's uncommon interface and lack of wizards force users to learn the program well before creating 3-D scenes or animations. But once mastered, trueSpace can still compete with more expensive packages for fast modeling and spectacular output.—*Daniel B. Levine*
trueSpace 2. List price: \$795. Requires: 386-based PC or better, 8MB RAM, 8MB hard disk space, Microsoft Windows 3.1 or later. Caligari Corp., Mountain View, CA; 800-351-7620, 415-390-9600; fax, 415-390-9755; www.caligari.com. **Circle 515 on reader service card.**

Micrografx Inc.

Visual Reality

A conglomeration of 3-D programs—Renderize Live, Simply Scenes, Visual Catalog, Visual Font, Visual Image, and Visual Model—constitute Micrografx's \$259 Visual Reality 2.0. The programs all fit together loosely, with fair-to-poor integration, so Visual Reality only sometimes works as it should.

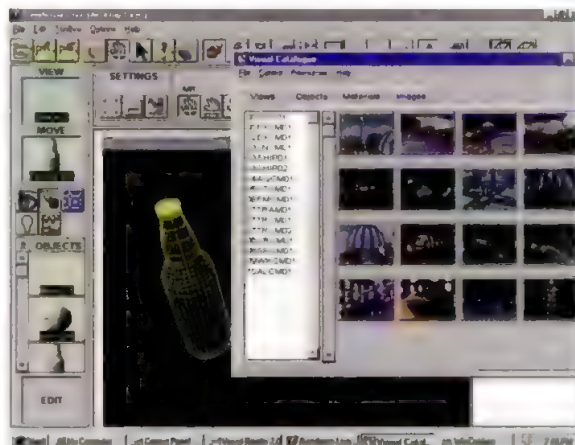
Visual Model is the module in which you can draw 2-D and 3-D shapes. It's a rudimentary program that does not provide spline-based tools. Moreover, it isn't easy or always possible to edit models created within Visual Model. Even Micrografx has acknowledged that this portion of Visual Reality is worthy of retirement.

On the other hand, the Visual Font module allows for extensive and accessible customization of extruded TrueType fonts, with different bevels, fillets, depths, shapes of paths, deformations, and the like. Options are interactively controlled using sliders, and the previews are large and detailed. The bevels, deformations, and paths are preset and not customizable, however, and you have no control over kerning. Even so, Visual Font is a superbly useful program that creates beautiful 3-D type.

Renderize Live is at the heart of Visual Reality. Here you lay out scenes, apply materials and maps, and create animations. Though the program's somewhat garish interface doesn't look like that of any other 3-D software package, it does make a strange kind of sense once you understand it. Objects, materials, images, lights, and views appear on toggle lists that show items as large icons. You click

on and drag any icon into the View Well, Move Well, or Edit Well to work on it. Other icons let you toggle between moves, color tools, render, and pick.

Placing materials and images onto objects is not difficult. Another module, Visual Image, provides some image-editing tools, but you can't apply any image di-



Visual Reality's Visual Catalog (right) helps the user choose from among the views, objects, materials, and images in the Simply Scenes CDs.

rectly to an object. You must first define it as part of a material.

Though Renderize Live's animation uses a standard keyframe structure, it's implemented in a difficult and convoluted way. First, even if you don't want to animate the camera, you must define a camera animation. And that dialog needs to stay up on your screen while you define any motion—including those created using the object-animation dialog. The result is a cluttered screen. Renderize Live lets you animate primitive objects directly, but we recommend that you create null nodes or parents for any relational animation, more complex objects, or links.

Theoretically, animation/object hierarchies and morphs are feasible, if not exactly easy to define. But beyond creating the simplest relationships, we had difficulty making them work in any practical sense. A poorly documented command-line feature

gives you functional control over lights, views, and objects (you can make a light follow a moving object, for example), but this doesn't always work. And making a camera follow a specific object can be a difficult and convoluted process.

But even worse is its tendency to change all your hard work before your eyes. Once a layout or animation is perfected, it's risky saving to the hard disk and closing the file; more often than not, when we reopened a file, definitions of objects and materials had altered, pieces had disappeared completely, and animations had changed. Micrografx acknowledged that this shouldn't occur but said these errors could take place if object files are stored in separate directories.

Rendering to screen is push-button-easy, very quick, and nicely detailed. But the final scanline rendering as a still image or an animation is somewhat crude, as it lacks the finesse of procedural textures, displacement mapping, and other features.

Included with Visual Reality are six CDs of 3-D clip art and textures. Though it's interesting to click and drag textures, materials, and shapes from the precreated fantasy worlds with the Visual Catalog module, doing so is not very productive. To find a glass material, for example, we had to search through all the CDs. Visual Catalog would be much more useful if it allowed the user to place together all the glass objects and textures, all the wood items, and so forth.

Visual Reality will still be available for some months after Micrografx releases a revised and renamed product, which should be out by the time you read this. We hope this new release will improve on Visual Reality's shortcomings. In the meantime, we recommend looking elsewhere.—*DG and SWG* □

Visual Reality 2.0. List price: \$259. Requires: 486-based PC or better, 12MB RAM, 40MB hard disk space, Microsoft Windows 3.1 or later. Micrografx Inc., Richardson, TX; 800-669-7318, 214-234-1769; fax, 716-873-0906; www.micrografx.com. **Circle 516 on reader service card.**

SUITABILITY TO TASK

Visual Reality

	Power	Ease
Modeling	Poor	Fair
Rendering	Good	Good
Animation	Fair	Good
Scene composition	Fair	Fair

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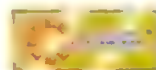
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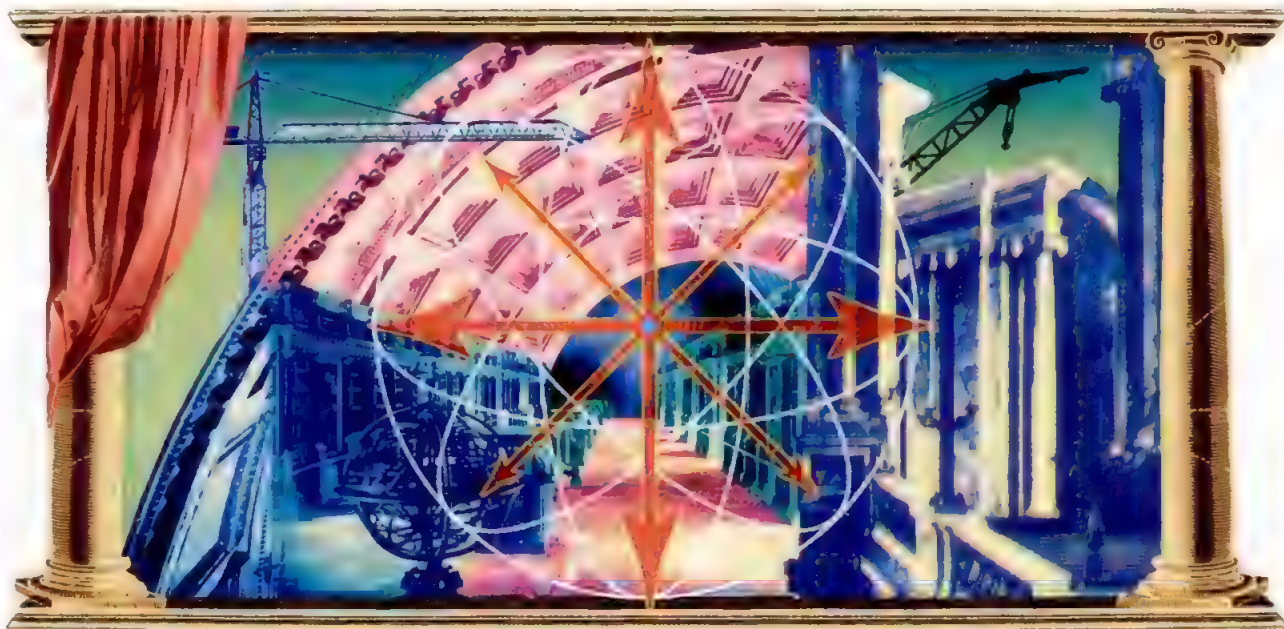
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VRML builders and browsers open up exciting new three-dimensional worlds on the Web.

VRML is interactive 3-D for everyone, a communications medium that lets us build and experience new worlds modeled on aspects of the world we know. VRML browsers let you travel through the many 3-D worlds already on the Web. VRML world builders let you create your own worlds for others to explore. People can tour your plant, visit your golf course, meet with you in your cybercafe, or link to pages about your company and products. Moving in a 3-D space doesn't cut you off from 2-D; you still have images, video, and audio. But now you have 3-D space, too—the most compelling interface metaphor of all.

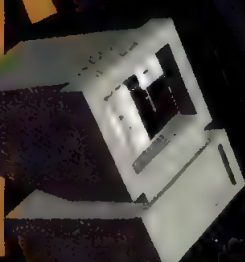
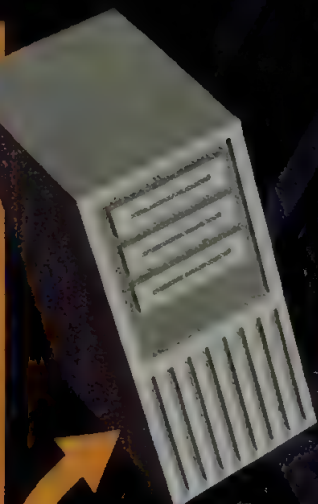
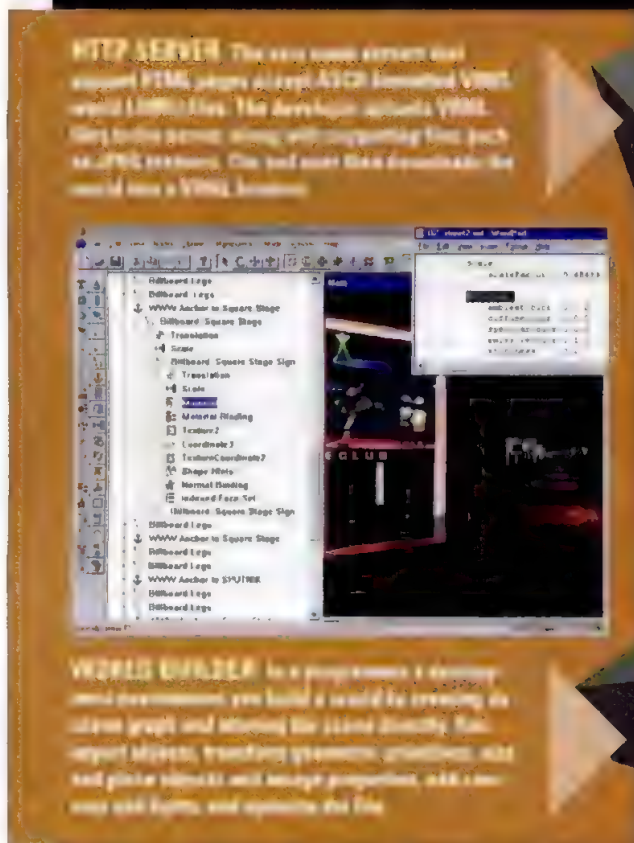
This isn't HTML, it's VRML (Virtual Reality Modeling Language, pronounced "ver-mal"): the 3-D analog of HTML,

By Linda and Erick Von Schweber

Touring Hyperspace

Building and participating in 3-D worlds on the

SCENE GRAPH The structure and content of a VRML file is a hierarchy of objects, attributes, materials, lights, and cameras. The scene graph is the object-oriented centerpiece of VRML, making platform-independent 3-D on the Web possible.



which describes worlds and links using an ASCII text format that VRML browsers read. VRML can be used to model places in the real world or to build fictional worlds having two or three dimensions, such as those found in games. A third trend, in which VRML worlds become metaphors to communicate the unknown by analogy with the familiar—using 3-D buildings in a virtual skyline, for instance, to represent stock-trading activity—is another potentially fascinating application of the technology. And then there are totally abstract applications of VRML, in which three-dimensional spaces can enable us to visualize huge name spaces such as the Web itself.

The 5 world builders and 11 VRML browsers we review here conform with the original VRML 1.0 specification already in wide use. They also establish the foundation on which newer VRML 2.0 versions of these tools are being built. As we go to press, the VRML 2.0 specification has just been ratified. We expect most vendors to have released VRML 2.0 versions of their VRML products by the time you read this.

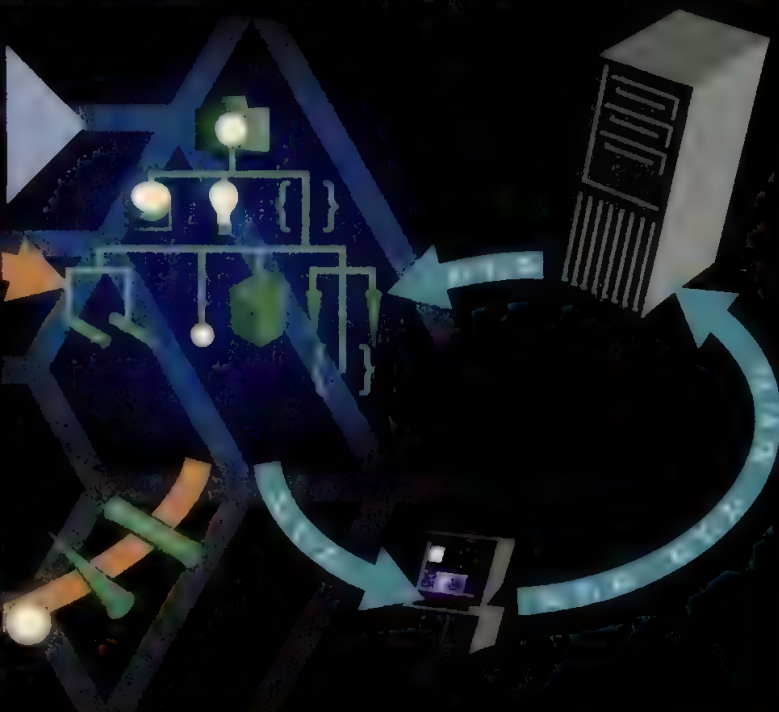
VRML TECH

VRML was designed from the beginning to view real-time 3-D over the Web. A VRML browser, be it a plug-in, helper, or

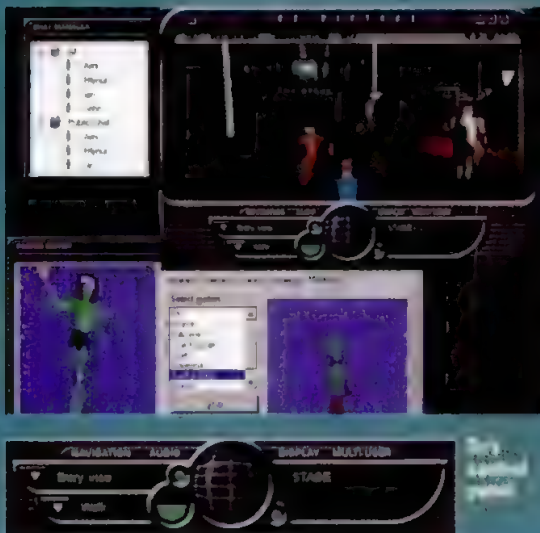
standalone application, is a real-time 3-D rendering engine, the same technology used in traditional virtual reality (VR). This sets VRML applications apart from three-dimensional modeling and animation applications, which prerender fly-throughs that take you on a ride but allow you no freedom of choice as to where you go. VRML offers six-plus-one degrees of freedom: You can move along three directions and rotate along three orientations, as well as hyperlink to other 3-D spaces. VRML is hyperspace.

VRML models 3-D worlds with a

Web today, tomorrow, and beyond.



AVATAR WORLDS The promise that VRML holds for the future is in the increasing viability of avatar worlds—online communities where you, represented by an avatar, will meet with others in a VRML world. An avatar server will track each avatar's position, represented by the x-, y-, and z-coordinates.



VRML 1.0 BROWSER A VRML browser, a real-time 3-D rendering engine, downloads a VRML 1.0 file from an HTTP server and enables you to navigate it with six degrees of freedom (moving along three dimensions, rotating along three orientations) and link to other URLs. Here, Vream's WIRL navigates a Lightscape radiosity-textured space station.

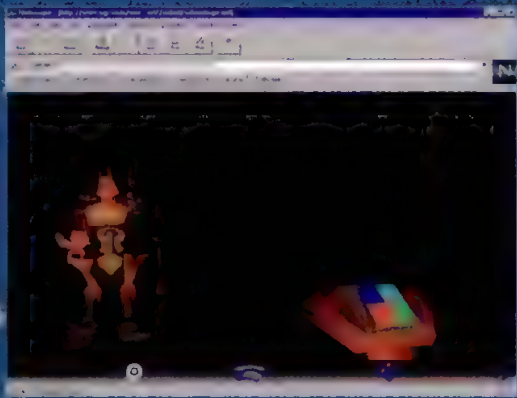


Control
walk
control

VRML 2.0 BROWSER VRML 2.0, recently ratified as the new specification for building 3-D worlds on the Web, allows for worlds that are animated and responsive. You navigate and interact. Here, the first beta of a VRML 2.0 browser (SGI's Cosmo Player) shows a robot whose actions are controlled by the colored keys.



WIRL's
walk
control



data structure called a scene graph, a format based on the Open Inventor 3-D toolkit developed by Silicon Graphics Incorporated (SGI). The VRML scene graph is a hierarchy of nodes representing all static aspects of a 3-D scene: geometry, materials, textures, geometric transformations, lights, viewpoints, and nesting structures. Nearly all vendors of three-dimensional products—whether CAD, modeling, animation, VR, or VRML—have scene graphs at the core of their architectures.

VRML parallels HTML in many ways.

The VRML file type, .WRL (for *world*), is made up of human-readable ASCII text. Thus, in skilled hands a text editor can become a VRML world-building tool. But just as tools now exist for building HTML pages without writing a single line of HTML, so too are there VRML builder products that let you create VRML worlds without ever editing a .WRL file.

VRML 2.0: MOVING WORLDS

The VRML 2.0 specification, finalized in August 1996, is based on SGI's Moving Worlds proposal. The name signals what

VRML 2.0 is all about: motion and world dynamics. Want lights to turn on with a virtual switch, the sound of an animated water fountain to grow louder as you approach, and buses to zoom by or stop and pick you up if you flag them down? All this can be accomplished through five simple constructs in VRML 2.0: node event fields, routes, sensors, interpolators, and script nodes. The first four constructs connect and control actions, reactions, and animations. The script node contains JavaScript, or a reference to an external Java applet allow-

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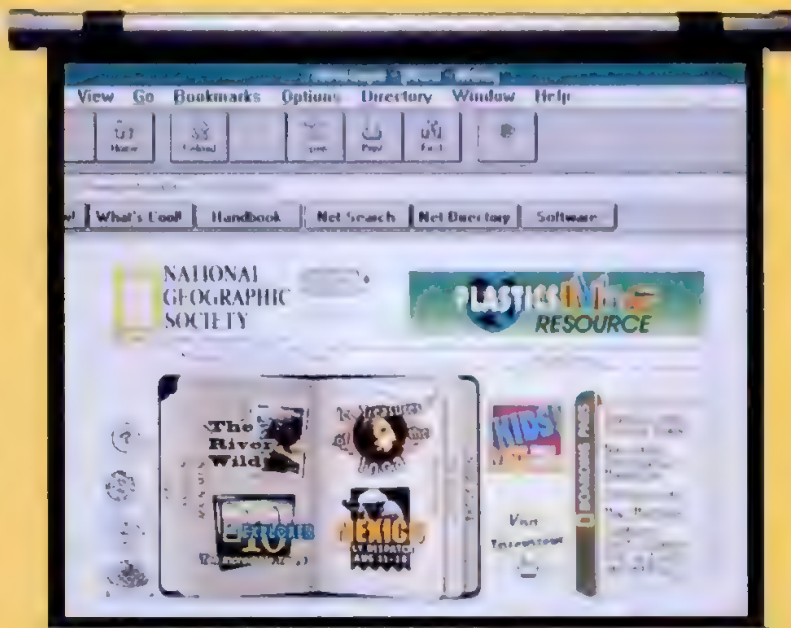
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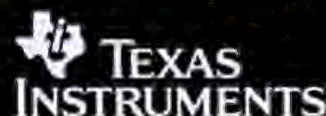


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TECHNOLOGY FROM TEXAS INSTRUMENTS.



ing developers to extend the behaviors and dynamics of VRML. Two special VRML node types, Proto and Extern-Proto, can dynamically extend VRML by directing your VRML browser to download whole new packages of VRML functionality from the Web.

The new VRML 2.0 specification enhances the look of VRML, too. It provides gradient and texture-mapped backgrounds, sounds tied to locations in the world, and a MovieTexture node that maps MPEG-1 video onto arbitrary objects. It also provides for contoured terrains, extrusions, collision detection, fog, and text that always faces the user.

THE VRML TOOLBOX

There's no single, perfect tool for all levels of VRML authoring. World builders usually fall within one of three general categories: those targeted at the programmer, those aimed at the hobbyist, and those for the design professional.

Programmers familiar with the VRML language want the total control and flexibility offered by direct manipulation of the scene graph. In this category, we review V•Realm Builder from IDS. The dominant products in the entry-level category, ParaGraph Corp.'s Virtual Home Space Builder 2.0 and Virtus 3-D Website Builder, let hobbyists produce worlds from within a single authoring environment. Both let users pick scene objects from a library and provide a specialized modeler to create rooms and walls. Design professionals and multimedia artists who want power within an intuitive point-and-click environment still have limited options. In this category, we review Pioneer Pro from Caligari Corp., the maker of trueSpace, a 3-D modeling package, and Radiance Software's Ez3D VRML Author Pro 2.0. One caveat with this group is that although 3-D modeling tools offer great design freedom, they often produce worlds too large and detailed for real-time use.

If you expect to be a casual viewer of

Editors' Choice

- World builder: V•Realm Builder
- VRML browser: WIRL



In the burgeoning VRML world-builder market, professional developers need tools that facilitate producing attractive worlds that will download

quickly and render faithfully. Of the products that we review, V•Realm Builder from Integrated Data Systems best met this ideal. It allows you direct control over the scene graph to optimize your world and take full advantage of all the features in VRML 1.0. And at \$250 on the street, no one offers the power V•Realm provides at anywhere near the price.

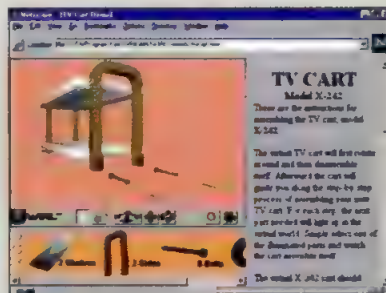
V•Realm offers full functionality as well, including ways to implement essential VRML 1.0 nodes with relative ease for the professional. The development environment enables you to switch easily between editing the scene graph and editing the scene view, automatically updating any changes that you make to one in the other. V•Realm also provides an array of toolbars and palettes for each node in the VRML spec, so an elegant solution exists for adding elements like lights, textures, and basic geometries.

Of course, everyone wants to view

these 3-D worlds on the Web, and no browser is better than WIRL, free from Vream. WIRL has unmatched navigation controls that are intuitive, powerful, and unobtrusive. No browser performed better in terms of hardware acceleration on our informal tests using a 3-D accelerator board. WIRL was also one of the most competent VRML 1.0 browsers at loading worlds from a variety of building environments, and it can plug in to both Netscape Navigator and Microsoft Internet Explorer to

provide a near-total VRML 1.0 browsing solution.

Honorable mention for world builders goes to Virtus 3-D Website Builder. This \$119 product makes a great introduction to VRML for anyone, and it provided the most fun and created the least frustration of any builder we saw. You can build attractive, reasonably efficient worlds in just a few hours. You start with a prebuilt room, create the doors and windows, and then add any of over 1,200 included objects, using an easy drag-and-drop system.



3-D on the Web, Netscape Navigator bundles VRML-viewing capability with its 3.0 release. If you enjoy exploring these worlds, high-quality navigation controls, proper rendering, and speed will become increasingly important to you, and you may want to select one of the many browsers or plug-ins that we review in this story. Developers should

maintain a collection of all of the major browsers for compatibility testing, because significant differences in their performance do exist.

COMMUNITY EFFORT

The industry-wide support for VRML 2.0 is as remarkable as the technology. Many important vendors clearly consider VRML 2.0 to be the keystone of their architectures.

SGI, the most influential VRML player, has introduced Cosmo3D, a C++ VRML 2.0 API, as the basis of Viper, its new tools architecture. Add-ons to

Our Contributors: LINDA AND ERICK VON SCHWEBER are founders of Infomaniacs, a think tank in cyberspace (www.infomaniacs.com) with an outpost in Sedona, Arizona, specializing in the convergence of 3-D, VR, multimedia, very large databases, and the Web. JAY MUNRO was the project leader, and DAVID LIDSKY was the staff editor in charge of this story.

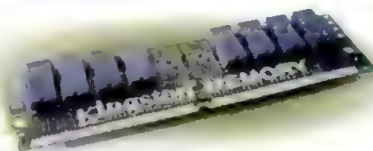


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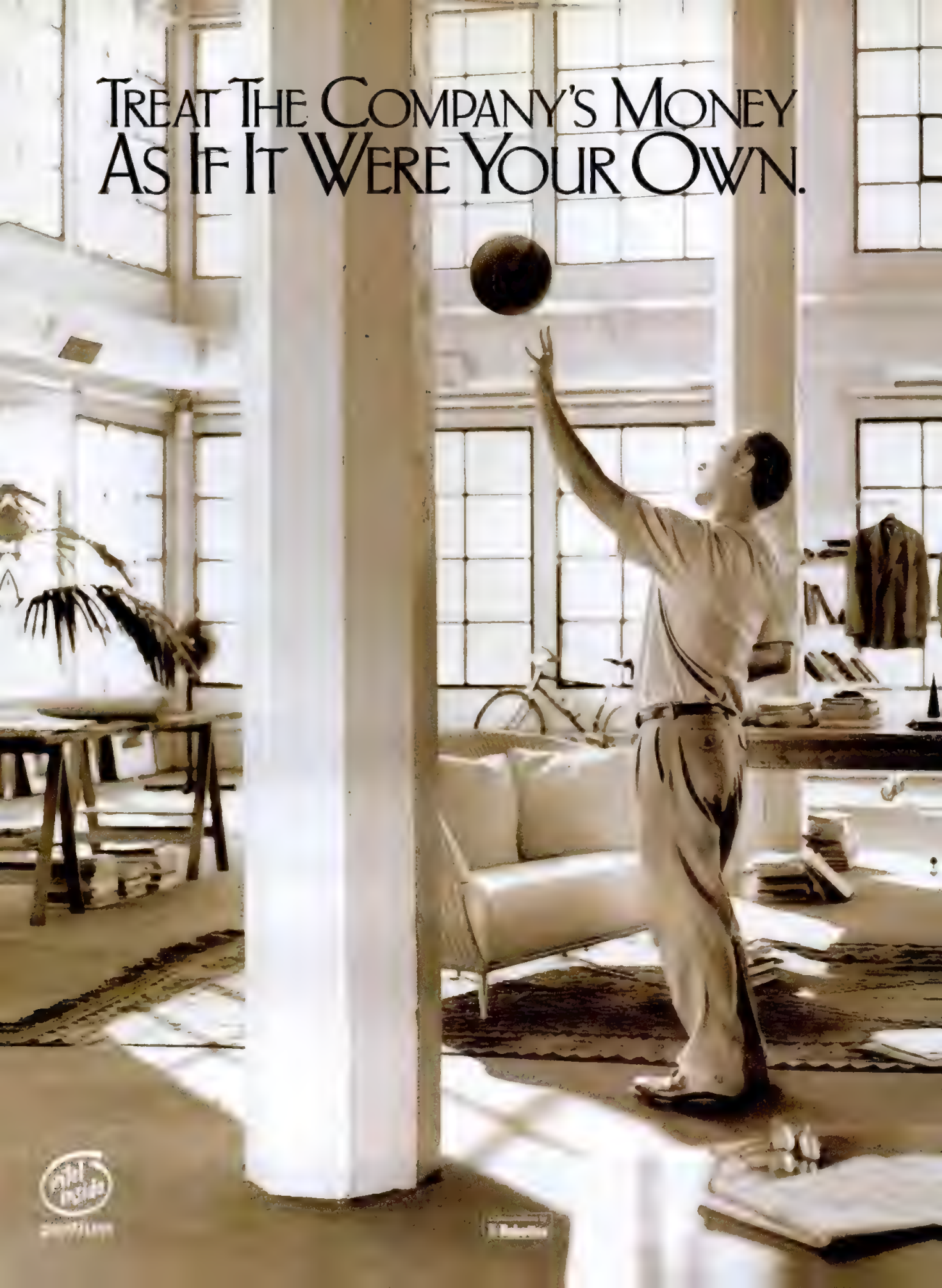
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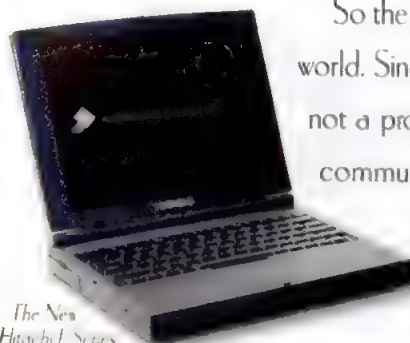


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Cosmo3D support applications written to SGI's existing tools (Inventor, Performer, and Image Vision), which become plug-in personalities with Viper. SGI is also supporting VRML 2.0 with best-of-breed tools. The vendor's new Cosmo Player browser, now in beta testing, will be the first totally compliant VRML 2.0 browser for Windows 95, Windows NT, and IRIX. In the works for a fall release is Cosmo GL, a Windows 95 version of OpenGL optimized for the Intel Pentium. In the works is also Cosmo Worlds, with modeling tuned to real-time 3-D and offering unique visual feedback for the designer. Cosmo Worlds will be a definitive builder environment, although it won't initially serve the PC platform.

Sun Microsystems, the Java pioneer, recently chose VRML 2.0 as the functional core of Java 3D, its Java-based 3-D API.

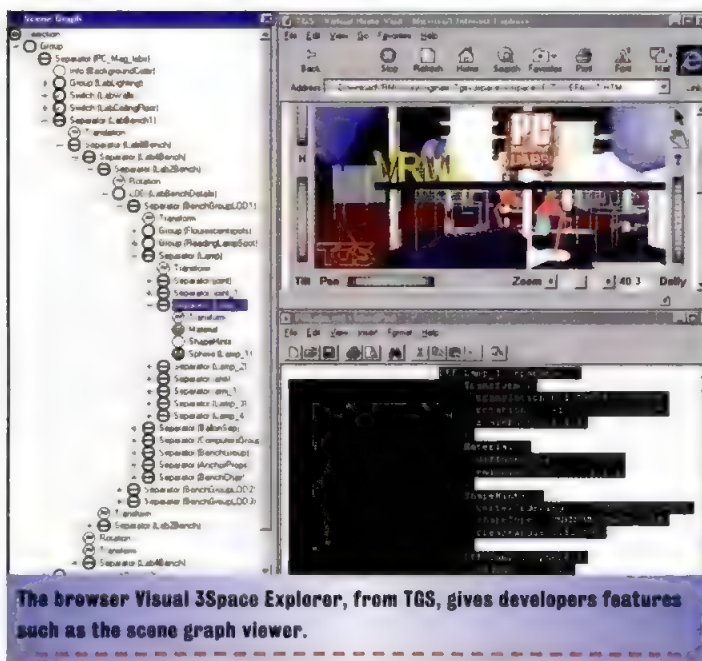
Microsoft is also committed to the VRML 2.0 standard, and has licensed DimensionX's Java-based Liquid Real-

ty to create an ActiveX component for VRML 2.0 browsing. Microsoft's optimized OpenGL 1.1, found in Windows

VRML 2.0 browser. The company is extending Navigator's architecture so that a plug-in's display can be mapped onto 3-D objects in the VRML scene, the beginnings of a three-dimensional interface to existing two-dimensional content. IBM and Apple are working with ParaGraph on a VRML binary format featuring compression of geometries, which will reduce file size up to a factor of 50 and open up VRML to a wider range of users.

Today's VRML technology is just a beginning. The future that VRML promises will be collaborative, participatory, distributed, and pervasive. When we communicate through standard two-dimensional technologies, we are remote observers, outside the content.

But when we use VRML, we are located in three-dimensional space, connected with content as involved participants. The builders and browsers that we review in the following pages allow us to enter that space today.



NT 4.0, will soon be available for Windows 95, while its Direct3D has already demonstrated its mettle with hardware acceleration.

Netscape is at work on Navigator 4.0, which will include a fully capable

THE WEB GOES 3-D

How to Read the Suitability to Task Boxes

Object modeling Developers need efficient modelers that understand both real-time rendering over the Internet and the need for low polygon counts. Products fare well if they offer help in reducing object complexity, if they assist you in maintaining a low number of polygons as you create new objects, and if they allow you to shape both curved and irregular objects. Products fare poorly if they encourage and enable the construction of objects so complex that they cannot be rendered well in real time.

Virtual space modeling In order to produce realistic worlds, good programs include objects such as rooms, walls, floors, and doors, as well as sky and ground colors. Tools that help you build walls, cut out windows, apply wallpaper, and paste pictures onto objects improve a builder's rating. A product with a floor-plan editor and the ability to locate objects on the ground plane automatically rates highly. Painstakingly sizing

SUITABILITY TO TASK		
Product name	Ease	
	Power	Ease
Object modeling	Poor	Poor
Virtual space modeling	Fair	Fair
Scene construction	Good	Good
File optimization	Excellent	Excellent

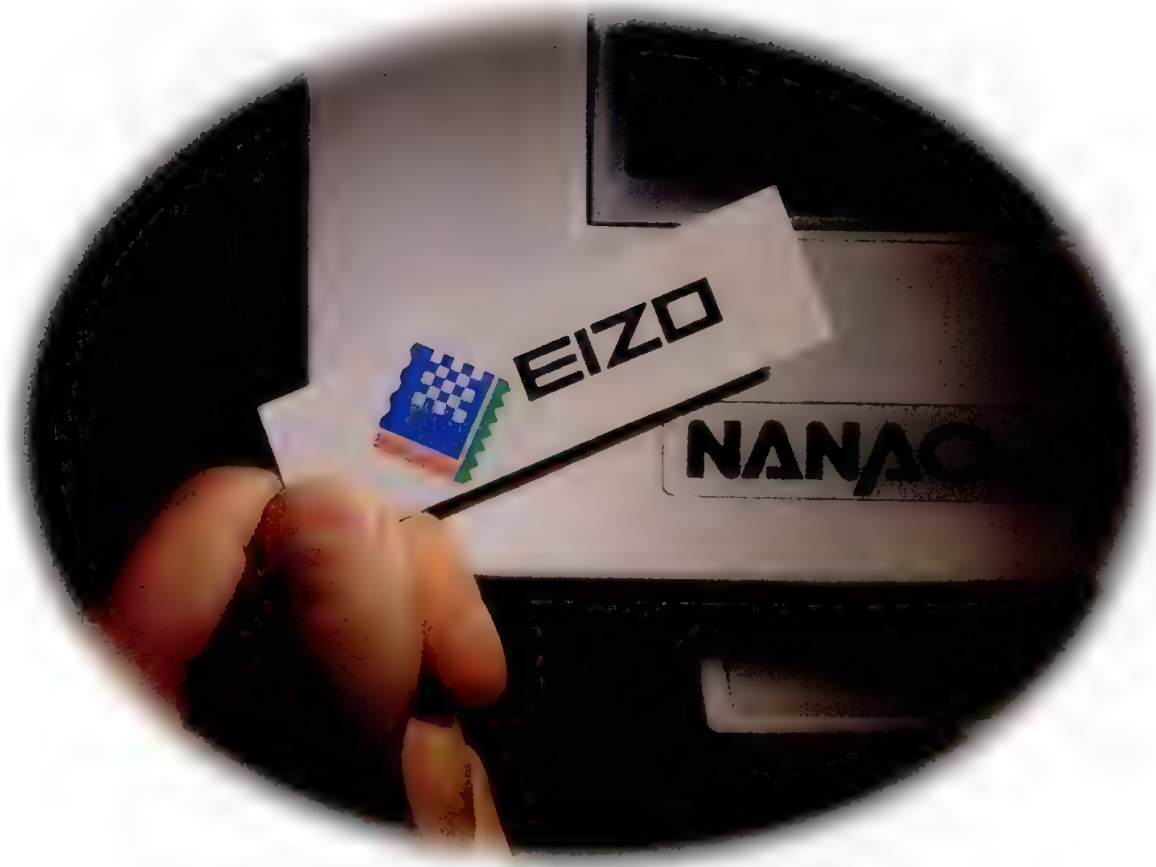
N/A—Not applicable: The product is not designed to carry out this function.

and positioning cubes is not our idea of virtual space modeling; if a product offers no more sophisticated methods, we give it a rating of *poor* for ease of use.

Scene construction We look for tools that ease the placement of objects in a scene. Object file importing and conversion/optimization are essential. A good grid system and dialog boxes let you position and size easily. Tools should let you modify geometry when necessary. Lights and cameras should be easy to set up

and aim. The program must write out properly to the world (.WRL) file. We also look for the ability to attach WWW Anchors (URLs and URNs) to objects as well as to in-line objects and textures.

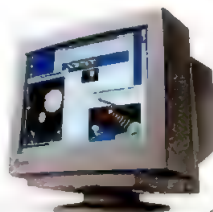
File optimization A well-designed builder offers a range of features to optimize world files, enabling quick downloads and smooth rendering. *Instancing* lets you specify an object and its qualities once, then reference that specification for every variant of the object in the scene. *WWW Inlines* let you load objects from any URL on the Internet. *Level of Detail* lets you create an object that appears more detailed as you continue to get closer to it in the scene. You need elegant controls to harness such power, so we give extra points for direct access to the scene graph and its parameters. Some products perform file optimization automatically; these receive *excellent* ratings for ease of use.



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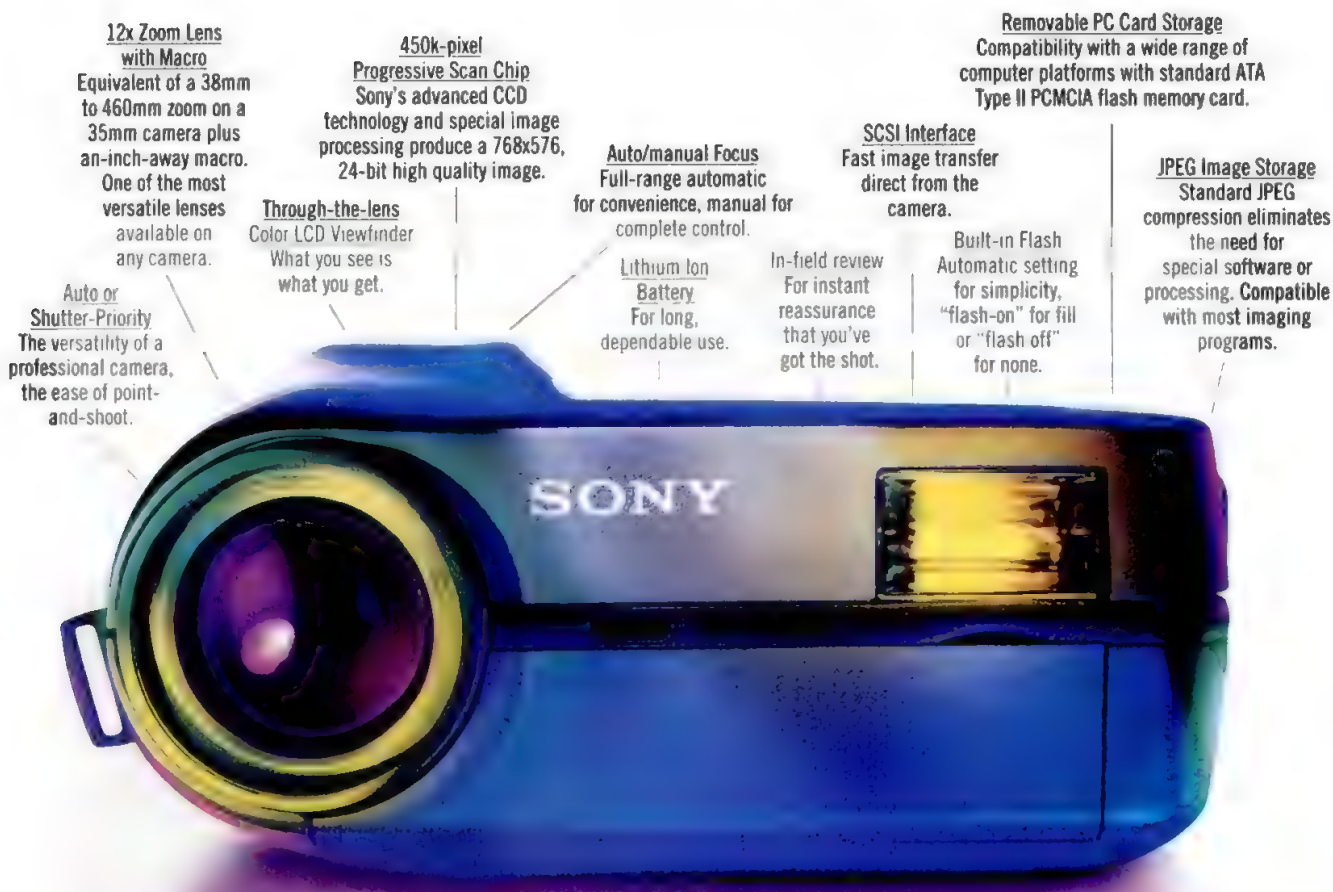
As you can see, the more things change, the more they stay the same.



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Ez3d VRML Author Pro 2.0

ALL REVIEWS BY
LINDA & ERICK VON SCHWEBER

A solid, albeit relatively pricey, offering from Radiance Software, Ez3d VRML Author Pro 2.0 lets you build small worlds relatively efficiently. Building on Open Inventor (the prototype for VRML) and featuring an SGI-style interface, this \$2,495 program is designed for the VRML developer. The product is well documented, so it was easy to get Ez3d up and running. Difficulties with its precision in handling floating-point numbers, along with its being so much more expensive than competitors with similar functionality, make it difficult to recommend.

Ez3d's modeling capabilities are industrial-strength and encourage the simple movement of vertexes (the points you see in a wireframe model) rather than increases in complexity. Ez3d can easily merge objects, thereby reducing their total complexity. Modeling options include primitives, 2-D and 3-D text, and even single lines and faces, thus ensuring that you initially have the simplest objects possible. (Beware, however: Ez3d's automatic complexity reduction can destroy a detailed model.) Ez3d can import files from Autodesk, Open Inventor, Wavefront, 3D Studio, and IGES and convert them to VRML.

SUITABILITY TO TASK

Ez3d VRML Author Pro

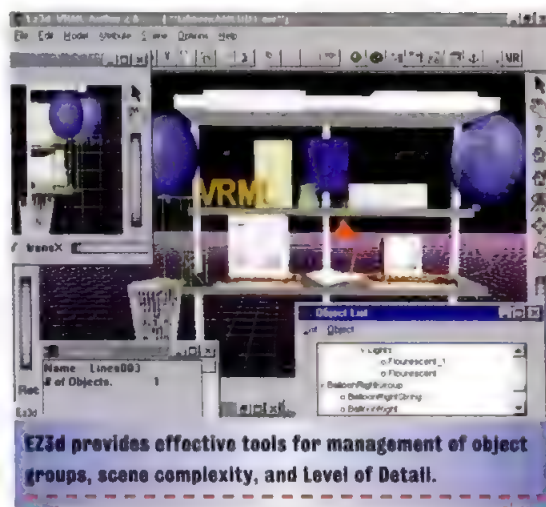
	Power	Ease
Object modeling	Excellent	Good
Virtual space modeling	Poor	Poor
Scene construction	Excellent	Good
File optimization	Good	Excellent

Modeling in Ez3d is not as simple as it is with Virtus 3-D Website Builder, in which you drag a cube onto the ground and simply walk inside. With Ez3d, walls are constructed from individual cubes and all primitives originate at the exact center of the world, so we found ourselves working out more math problems than we liked during modeling. One unacceptable bug, which Radiance says it's working on, is the way floating-point numbers are extended and rounded. We built the PC Magazine Labs test file only to find that 90-degree angles had turned into 89.97-

degree angles, resulting in spaces between the walls, some walls completely askew, and a ceiling that was coming apart from the walls.

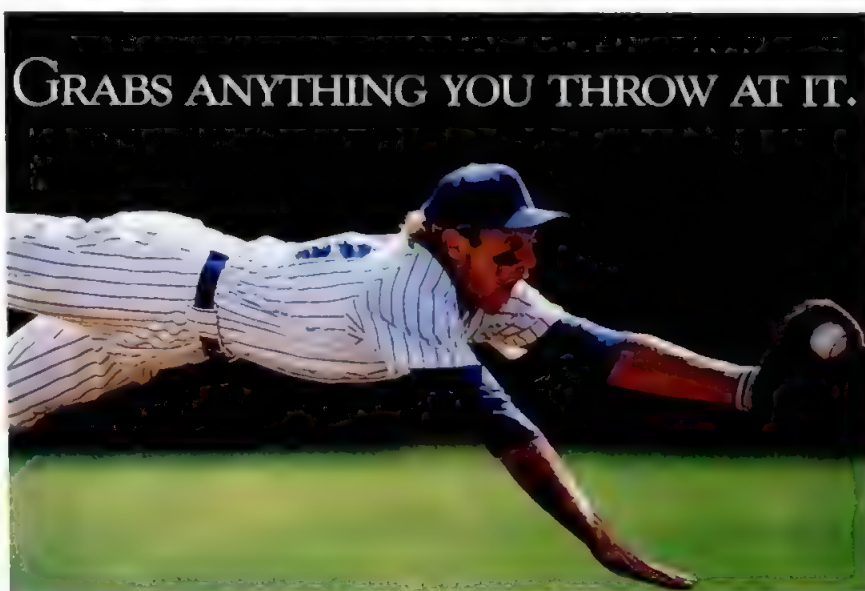
The 9-foot-tall lab bench up-rights in our test world file needed to be positioned 4.5 feet above their original position in order to locate them on the floor. You do this with a transform dialog in which you set translation (movement) values as well as scale and rotation. Like the many other dialogs in Ez3d, this one lacks a cancel button; luckily, the program's multiple-level undo feature works well. Models in Ez3d can be edited via dialog boxes or by dragging the manipulators that surround a selected object to create the desired effect.

Ez3d also includes advanced modeling features such as mirror and slice, and an object list that provides an excellent way to organize, group, and identify objects in a complex scene. Nearly all VRML features are supported, including Level of



Detail. WWW Anchors (URL links) are easy to attach, and Ez3d verifies the links for you. It will optimize your geometry into face sets and gZip the file.

The simplest file we built, which included a cube, a sphere, and a cylinder along with three lights, took up 9K (2K after compression). Considering that V•Realm Builder required only 1K to store a similar file before compression,



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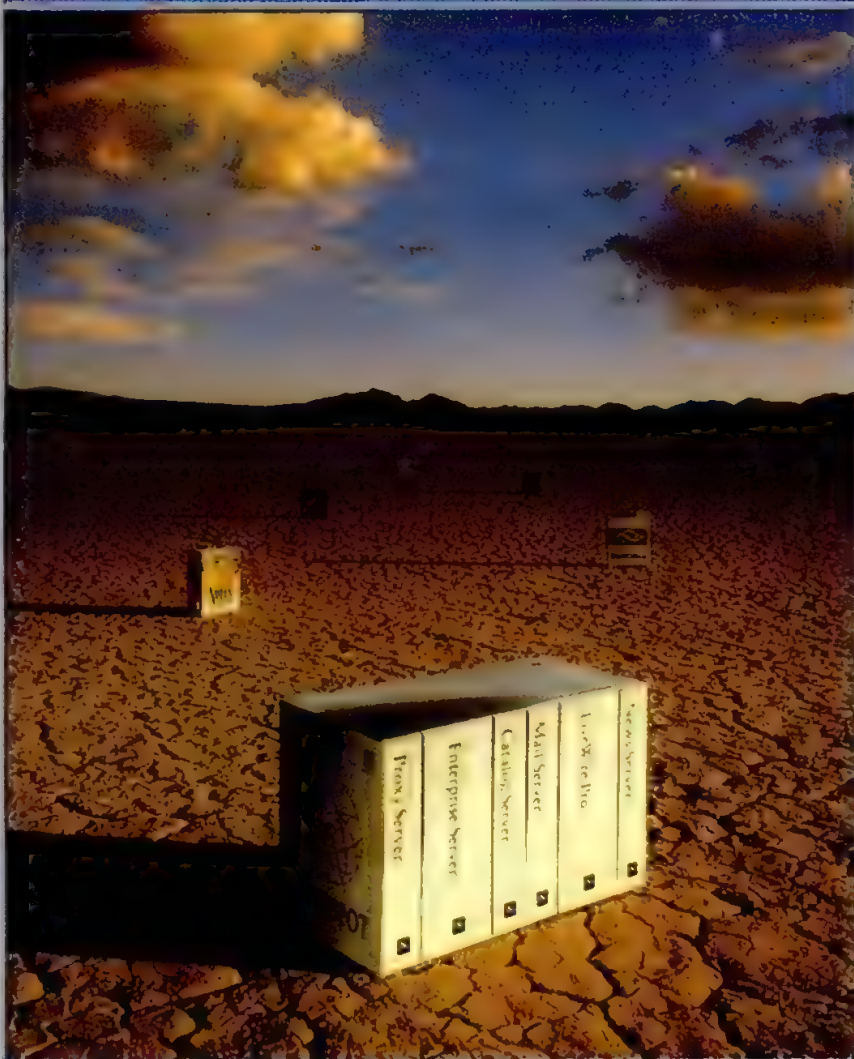
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Ez3d's optimization may not be sufficient for large worlds. Though Ez3d creates instances (in object-oriented terms), it doesn't allow you to define and use them explicitly. This means that if you use a chair (10 lines of code) six times, the file will contain six copies of the chair (60 lines of code), whereas the best optimization would describe the chair once and use it six times (16 lines of code).

You can easily set multiple camera positions by creating a camera when you have the scene displayed to your liking. This gives you all the standard viewer controls and thumbwheels with which to compose the scene, and protects you from camera definitions and transforms.

We liked Ez3d Author Pro, and we used it to create optimized objects for the browser test scene, but its floating-point problem and its lack of support for any animation or behaviors mean you may want to wait for Radiance's VRML 2.0 product, due by the end of the year. We find it difficult to justify Ez3d's price tag in its current form.

Ez3d VRML Author Pro 2.0. Direct price: \$2,495. Radiance Software International, Emeryville, CA; 510-595-2350; fax, 510-595-8160; www.radiance.com. Circle 441 on reader service card.

Caligari Corp.

Pioneer Pro

Combine the great interface and functionality introduced by Caligari's 3-D modeling and animation package, trueSpace, with the world of VRML and you have Caligari Corp.'s \$495 Pioneer Pro. Unfortunately, the techniques trueSpace uses to create beautifully rendered images create objects and geometries that are not optimized for the real-time rendering VRML requires (for a review of trueSpace, see "Ideas Taking Shape" in this issue). The net result is that you may be hard-pressed to produce a file that will download quickly and perform well in the real world of the 3-D Internet.

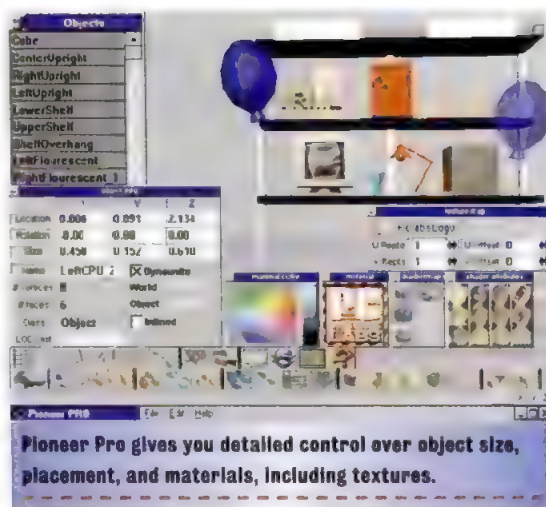
SUITABILITY TO TASK

Pioneer Pro

	Power	Ease
Object modeling	Good	Excellent
Virtual space modeling	Fair	Poor
Scene construction	Good	Excellent
File optimization	Poor	Fair

For example, even the simplest file we created, consisting of only a sphere, a cube, and a cylinder along with three lights, took up 12K of space, compared with 1K for a file containing the same elements built using V•Realm Builder. Modeling an object such as a simple coffee cup in Pioneer Pro, however, was a snap. In order to avoid unnecessary complexity, the trick is to avoid the fancy modeling techniques of point editing, Boolean joins, and sweeps whenever you can, and to restrict yourself to primitives as much as possible.

Pioneer Pro builds on trueSpace's interface, incorporating a few additions that create an environment for creating and testing VRML files. These include an integrated browser that supports Caligari Corp.'s own additions to VRML. TrueSpace's animation capabilities, however, do not carry over into Pioneer Pro's VRML world. We were able to load trueSpace files and save



them as .WRL (world) files, but don't be fooled by the ease of this process, as files designed for animations or still shots are seldom simple enough to make good worlds. At least Pioneer Pro helps you get started on the conversion process.

We had no difficulty creating our test lab bench. We created a primitive cube, used the object info box to set its dimensions and location, and then duplicated



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and moved it twice to create the three up-rights. We inserted monitors using the WWW Inline tool. Pioneer Pro let us easily link the cube and monitor objects into a Level of Detail group. This means that the monitors will only be downloaded and brought into the world if someone gets close enough to see them in detail. This tool is not properly implemented, however, as many browsers put the monitors on the floor instead of in place of the cubes.

Other tests revealed problems with Pioneer Pro's handling of texture maps. Most of the browsers reported error conditions and refused to load the textures at all.

When we went to import the red lamp, a .WRL file from *The VRML Sourcebook*, we had to follow the convoluted procedure of first loading it as a .WRL file, saving it as a .COB (Caligari object) file, and finally importing the .COB file as an object into our scene. Once it was there, however, we simply used the Object Move, Rotate, and Scale tools to position the lamp on the lab bench where we wanted it.

Loading our saved lab bench world into the browser produced some confusion, because it appeared turned around, facing away from us. Pioneer Pro's front view window is turned 180 degrees from its default perspective view. Add to that the fact that Pioneer Pro does not save its camera information properly in the VRML file, and you're going to have VRML browsers bringing you into the world at the back of the bench, from about a mile away, under it, or with it turned upside down.

Pioneer Pro's \$99 sibling, Pioneer, is a crippled version of the program that lacks the full features of Pioneer Pro's object info box, which provides the only way to size and position objects precisely in Pioneer Pro. You can best use Pioneer to add VRML-specific functionality to a scene modeled using trueSpace, much as other converters do (see the sidebar "VR and 3-D Players Eye the Web"). If you already use trueSpace, Pioneer or Pioneer Pro may be the choice for you—but remember that the program tempts you to create virtual worlds that just don't play well in the real world.

Pioneer Pro. List price: \$495. Caligari Corp., Mountain View, CA; 800-351-7620, 415-390-9600; fax, 415-390-9755; www.caligari.com. Circle 442 on reader service card.

ParaGraph International Inc.

Virtual Home Space Builder

A landmark product when it was released in July 1995, ParaGraph's Virtual Home Space Builder (VHSB) has aged well in the fast-paced VRML marketplace. Although its limited modeling and editing capabilities keep it from being a complete tool for professional VRML applications, VHSB (\$49.95) is still a great tool for those new to VRML because it ships with 33 worlds already built and decorated and another 52 empty worlds with walls ready for your family portraits. VHSB can also deliver a bit of multimedia razzle-dazzle, such as animated wallpapers and 3-D movies, in a way that is compatible with VRML 2.0. In fact, it is the only product found in our roundup that can already produce VRML 2.0 files.

One of VHSB's most notable talents is its ability to handle bitmaps easily and efficiently. It can import and reduce the file size of virtually any PC-based bitmap file. You can see all the bitmaps in any directo-

SUITABILITY TO TASK		
Virtual Home Space Builder		
	Power	Ease
Object modeling	Poor	Good
Virtual space modeling	Excellent	Good
Scene construction	Fair	Good
File optimization	Good	Excellent

ry in the VHSB decorator box, and you can apply them as wallpapers (which can be animated), pictures (which can be brought up full-screen in full resolution), or as movies (if you have a numbered set of images).

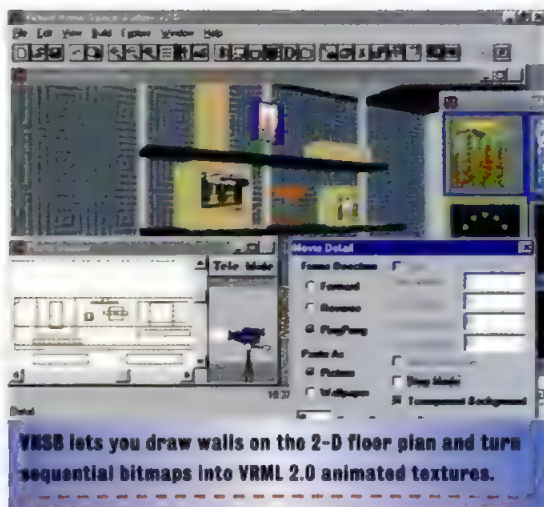
ParaGraph's second-generation VRML product, Internet3D Space Builder (ISB), which we looked at in beta, should be out by the time you read this. VHSB is much more limited than ISB will be, but some features will remain the same. You create a room by building a solid block and then cutting a smaller block out of it. You create doors and windows in the same way. You add a second floor by changing the building level and adding a floor at the new level. You're limited to straight walls and objects in VHSB, but ISB will introduce a full set of primitives and some easy modeling capa-



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bilities. VHSB can export world files but won't convert .WRL files created using other programs to its native .MUS (museum) format, so be sure to save your world in the .MUS format first. Again, ISB will

correct this limitation of VHSB.

VHSB's camera controls are without a doubt the best in the business. You are presented with an icon of a camera on a monopod, which you use to pivot the camera head up or down and make the monopod taller or shorter. The previous release, VHSB 1.0, suffered in ease of use because it had neither an undo nor an erase feature, but VHSB 2.0 corrects that defect and ISB promises to go much further with respect to both ease of use and capacity. Although we built the PC Mag-

azine Labs bench in VHSB 2.0 without any problem, once we built a shelf it had to be placed exactly where we wanted it, because we couldn't move objects around. In ISB, however, we could not only adjust the

shelf's location as often as we liked, but we could also rearrange its position in the scene graph, a visual depiction of the hierarchical grouping used in VRML.

The prebuilt worlds that come with VHSB are a boon to VRML neophytes. They make it easy to create fun projects, such as publishing your house or office on the Web or assembling a virtual photo album by layering pictures on top of each other and then flipping through them. Product catalogs and virtual galleries are easy to produce in this way. You can add a WWW Anchor to a friend's photo and transport people to her home page. VHSB is undoubtedly the best suited of all the products we reviewed to building DOOM-like tunnels and runways. And with animated wallpapers, it's very easy to construct bridges over lakes of molten lava and create rooms full of exploding fireworks.

VR and 3-D Players Eye the Web

The VRML 2.0 specification, ratified this past August at Siggraph 96, has prompted both traditional VR and 3-D modeling and animation software vendors to scramble to enter the VRML market. The VR vendors offer VRML 1.0 and 2.0 support, as well as proprietary formats for VR supported by their own browsers, and the 3-D vendors offer VRML conversion tools that promise much more than file conversion.

Only days away from finalizing its WWW Anchor support, Sense8's **World Up** (www.sense8.com) was not ready for our review. The \$4,000 product is designed for full VR and interactive simulation production, with behaviors written in a VB-like scripting language. World Up provides a visual development environment for object-oriented programmers and a proprietary Netscape plug-in for browsing; it also exports geometry in VRML 1.0 format.

Realimation Space Time Editor (\$299) (www.realimation.com) is Datapath Ltd.'s real-time simulation and game development environment, with tools for creating path-based spin, linear, and circular real-time animations. But

if you want to wire cause and effect actions, you'll need the \$10,000 Realimation API.

Lightscape Technologies (www.lightscape.com), a maker of renderers for SGI and Windows NT platforms, can improve VRML performance and visual quality. The company offers a new twist called *radiosity*, a step beyond ray tracing that captures the effects of indirect light—often 80 percent of the light we see. This fall, Lightscape will add the ability to import a 3-D scene, compute radiosity off-line, and create texture maps with radiosity lighting to its **Lightscape Visualization System** (Windows NT version, \$2,995).

Some vendors have already prepared for VRML 2.0 and are nearly ready to ship products. Vream's **VRCreator 2** (\$99; info at www.vream.com) will provide over 1,000 objects and behaviors, including walls with doors that know how to open and close. VRCreator features powerful modeling and layout tools, as well as visual behavior creation in JavaScript, VreamScript, and Java. It's VRML 2.0-compliant, with cause-and-effect object links and properties

such as movable and throwable.

ANIMATORS GET INTO THE ACT

Some 3-D vendors have already released converter programs for VRML 1.0 and 2.0. For full reviews of these products' 3-D capabilities, see "Ideas Taking Shape." **3D Studio Max**, from Kinetix (\$34.95; www.ktx.com), shows great promise as a professional VRML 2.0 production environment. Lacking only scene graph optimization and .WRL file import capability, the Max VRML2 Plug-in lets you create (and optimize) objects and limited animations within Max and activate them via VRML 2.0 sensors. You can assign a WWW Anchor to an object or mark it for HyperWire, Kinetix's tool for visual creation of Java behaviors.

TriSpectives Professional, from 3D/EYE (\$99; www.eye.com), imports and outputs VRML files and is already considered by many VRML developers to be the premiere VRML modeling tool. TriSpectives Technical, to be released soon, will provide a full VRML builder environment, complete with WWW Anchor support.—Linda and Erick Von Schweber

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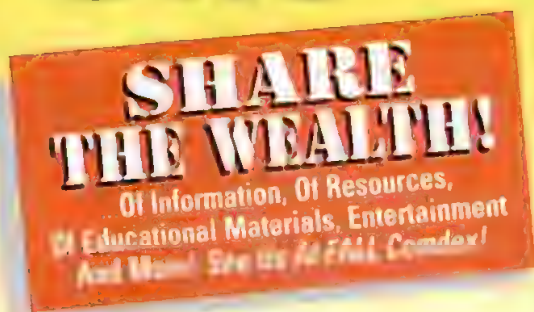


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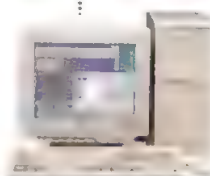
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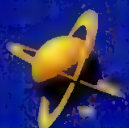
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Another plus is that both VHSB and ISB can be used on 486-based machines, and they perform very impressively on a Pentium-based computer. You won't need to upgrade just to play. By the time you read this, ISB will be on mass-market shelves for under \$100. These products provide an easy and inexpensive way to begin building VRML worlds, and should definitely be on your list if you want lots of capability at a price that's easy to live with. **Virtual Home Space Builder 2.0.** Direct price: \$49.95. ParaGraph International Inc., Campbell, CA; 800-258-7346, 408-364-7700; fax, 408-374-5466; www.paragraph.com. Circle 443 on reader service card.

Virtus Corp.

Virtus 3-D Website Builder

More people have been successfully exposed to VR by Virtus than by any other vendor, and Virtus 3-D Website Builder will open up the possibilities of 3-D on the Web to even more. You won't find another product that makes world building easier or more fun. This \$119 package's intuitive interface lets you quickly create an impressive world that looks like you slaved over it forever. Its output loads impressively in most browsers, so it's perfect for spicing up your Web site or creating a 3-D slide show.

We built the model of a lab bench with two shelves and supports, an overhead light, chair, monitor, and computer in less than 3 hours. Afterwards, all we needed to do was scan the galleries Virtus includes for computers, monitors, keyboards, and



them bigger and then smaller again; to move objects short distances you must move them a great distance and then put them back where you want them.

Certain objects, such as letters and numbers, will not change color once you move them into your world from the 3-D object gallery. The gallery is very extensive, but the only way to build other objects is to modify and group the ones that already exist, an exercise that can prove tedious. You can only import objects you build using other Virtus products.

The product offers no lighting capabilities and you can't make curved lines or lines with squiggles. Neither will the program support the addition of your own text as a texture. Virtus could improve the documentation that ships with the product, and the lack of online help disappointed us. The product's manual didn't provide us with the information we needed to continue developing our world, forcing us to resort to trial and error.

3-D Website Builder, like VHSB, runs well on a 486-based computer, so almost anyone can enjoy VRML. The program also makes it easy to create links to other sites by adding a WWW Anchor (URL) to an object: Simply type the URL into a dialog box. You can then travel to another Web site by clicking on that object.

While Virtus Voyager, the browser that comes with 3-D Website Builder, turned out to be less than fully compatible with VRML worlds, the output of 3-D Website Builder was the most compatible across the browser spectrum of all the builders we evaluated. Worlds built with 3-D Website Builder looked better in

most browsers than they did in Virtus itself.

If you want more flexibility but like to keep things simple, consider Virtus WalkThrough Pro (reviewed in "Virtual Reality: Virtually Here," March 14, 1995). It has the same simple interface, lets you place WWW Anchors (URLs) in your world, and provides better support for customizing your world, using lights, cameras, and even Virtual I/O's i-glasses! product. But since the VRML extensions are not as well integrated into WalkThrough Pro, you'll have

to go through a few convoluted steps, such as converting bitmaps to JPEG format by hand.

Virtus has created 3-D clip art for the rest of us with 3-D Website Builder. So replace that slide show with a virtual walk around your office, plant, or store, or enliven your Web site with something beyond 2-D. For both the hobbyist and the tuned-in teenager, 3-D Website Builder provides a wonderful introduction to VRML.

Virtus 3-D Website Builder. Direct price: \$119. Virtus Corp., Cary, NC; 800-847-8871, 919-467-9700; fax, 919-466-4530; www.virtus.com. Circle 444 on reader service card.

Integrated Data Systems Inc.

V•Realm Builder



If you're serious about building VRML worlds on the Windows 95/NT platform, then V•Realm Builder from Integrated Data Systems is the one product you must have. High-quality VRML

development remains in programmers' hands for now, and the only way to build tight, efficient VRML code on the Windows platform is by taking full responsibility for constructing the scene graph directly. V•Realm Builder (\$250 street price), the best performer in our testing, lets you do just that.

V•Realm lets you use all the tools in the VRML 1.0 spec, such as instancing, WWW Inlines, and Level of Detail (LOD), to optimize a scene file intelligently, without requiring detailed coding.

SUITABILITY TO TASK

3-D Website Builder

	Power	Ease
Object modeling	Fair	Fair
Virtual space modeling	Excellent	Excellent
Scene construction	Fair	Excellent
File optimization	Poor	Excellent

any accessories we needed. We brought in and ungrouped objects and selected single components that we then set onto the virtual lab bench. We simply deleted the parts from the gallery we didn't use.

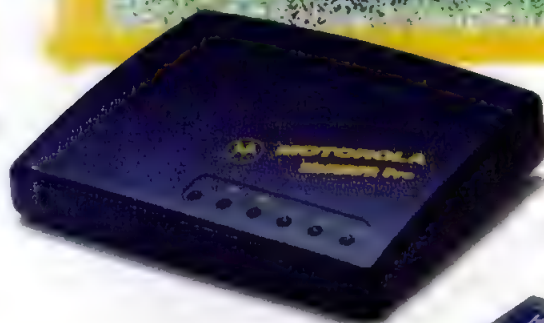
The program is not without its quirks. It's very difficult to make objects smaller and to move objects short distances. To reduce the size of objects you must make

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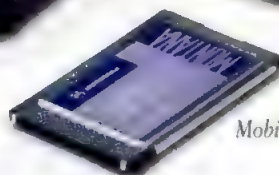
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SUITABILITY TO TASK

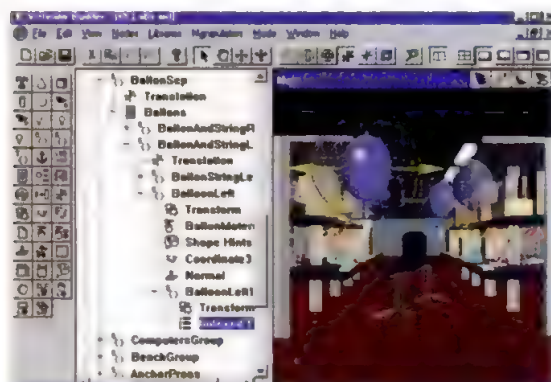
V•Realm Builder

	Power	Ease
Object modeling	N/A	N/A
Virtual space modeling	Poor	Poor
Scene construction	Excellent	Excellent
File optimization	Excellent	Excellent

representation of the world and then editing the scene geometry directly. You then return to the scene graph, where you insert, delete, and cut and paste nodes, and change their fields. Because you can edit the scene graph directly, you have total control over its structure and you can exploit all of VRML's optimization features. V•Realm doesn't force any structure on the scene graph, so you'll need some understanding of the VRML language.

We used V•Realm as a scene composition tool for constructing the PC Magazine Labs test world. V•Realm focuses on scene graph construction and file optimization, and it doesn't perform object modeling. We imported the lab bench and its objects, which we modeled using Ez3d for the most part, and grouped them under a DEF (definition) node. This was our bench object. We needed 24 of these benches to complete one section of the lab, and with instancing (through USE nodes), we created all 24 with a minimum of effort, and kept the file size down as well.

V•Realm's interface provides an outline view of the scene graph on the left and up to



V•Realm Builder gives you control over the VRML scene graph and contains manipulators for positioning objects.

SUMMARY OF FEATURES

VRML Builders

PC MAGAZINE
EDITOR'S CHOICE

■ YES ■ NO

Products listed in alphabetical order

General Features

	Ez3d VRML Author Pro	Pioneer Pro	Virtual Home Space Builder	Virtue 3-D Website Builder	V•Realm Builder
Direct price	\$2,495.00	\$499.00	\$49.95	\$119.00	\$250.00
Available for Windows 3.x/95/NT	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Full documentation via Help/Internet/manual	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Support via e-mail/Web/toll-free phone number	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Outputs VRML 1.0/2.0 files	■ ■	■ ■	■ ■	■ ■	■ ■
APIs supported	OpenGL	3DR GDI	None	None	OpenGL
Collision detection	■	■	■	■	■
2-D/3-D text editing	■ ■	■ ■	■ ■	■ ■	■ ■
Ambient/3-D spatialized sound	■ ■	■ ■	■ ■	■ ■	■ ■
VRML output contains default/multiple cameras	■ ■	■ ■	■ ■	■ ■	■ ■
Web anchor: User can embed URL/verify link	■ ■	■ ■	■ ■	■ ■	■ ■
Exports VRML to ASCII/compressed files	■ ■	■ ■	■ ■	■ ■	■ ■
Full publishing (uploading) capabilities	■	■	■	■	■

Integrated Editors and Libraries

Scene-graph editor	■	■	■	■	■
Lighting/full-environment editor	■ ■	■ ■	■ ■	■ ■	■ ■
Object editor/library	■ ■	■ ■	■ ■	■ ■	■ ■
Rooms and walls editor/library	■ ■	■ ■	■ ■	■ ■	■ ■
Texture applier/library	■ ■	■ ■	■ ■	■ ■	■ ■
Materials editor/library	■ ■	■ ■	■ ■	■ ■	■ ■

Object Modeling and Optimization Tools

Point light/Headlight	■ ■	■ ■	■ ■	■ ■	■ ■
Directional light/Spotlight	■ ■	■ ■	■ ■	■ ■	■ ■
Vertex/face edit	■ ■	■ ■	■ ■	■ ■	■ ■
Extrusion/Boolean modeling	■ ■	■ ■	■ ■	■ ■	■ ■
Sculpt surface/Spline point edit	■ ■	■ ■	■ ■	■ ■	■ ■
WWW inline	■	■	■	■	■
Level of Detail/Eye-range specification	■ ■	■ ■	■ ■	■ ■	■ ■
Texture in-line/Encode	■ ■	■ ■	■ ■	■ ■	■ ■
Geometry optimization	■	■	■	■	■
Explicit instantiation: Define/Use	■ ■	■ ■	■ ■	■ ■	■ ■
User controlled file-size optimization	■	■	■	■	■

four views of your lit and rendered scene on the right. When we clicked on the balloon in our scene, the scene graph outline window expanded the graph and displayed the balloon's node. If you double-click on a node in the balloon's section of the scene graph, you'll open up an editor for it, no matter what kind of node it is.

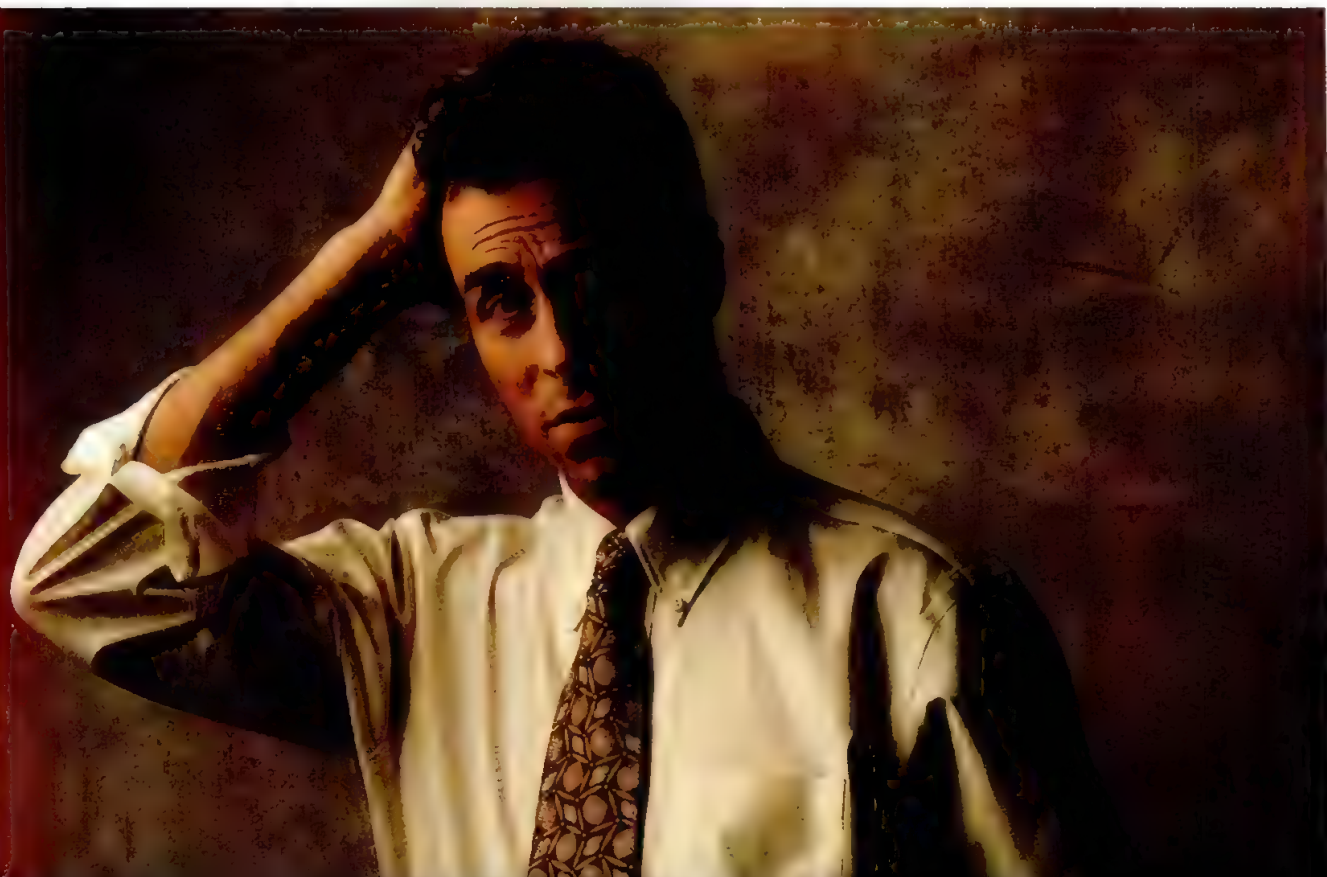
When sizing or positioning an object in your world, you choose the Position Ball Manipulator at the top of the screen. With it you can constrain movement of the selected object to any axis. The object's location coordinates are always displayed at the bottom of the screen.

While you position your object in a scene view on the right, V•Realm Builder adds a Transform node to the scene graph

displayed on the left, with the proper translation values entered in its fields. You can now choose to edit the fields directly, perhaps by entering a scaling value to reduce the object to half its visual size.

V•Realm performed the best of all reviewed products in terms of producing the smallest file. The simplest world we built, which included a cube, a sphere, a cylinder, and three lights, took up only 1K of space before compression because of V•Realm's use of VRML primitives.

IDS is already working on a VRML 2.0-compliant version, complete with novel ways to employ routes and create script nodes. V•Realm Builder is the place where worlds come together, and it should be in every world builder's realm. **V•Realm Builder.** Street price: \$250. Integrated Data Systems Inc., Savannah, GA; 912-236-4374; fax, 912-236-6792; www.ids-net.com. Circle 445 on reader service card.



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VRML Browsers

VRML browsers are more than display windows: They're complete real-time 3-D rendering engines with navigation controls that allow you to explore 3-D space and examine 3-D objects. Whether you're looking to browse a specific 3-D file format or surfing for hot VRML sites, our minireview of 11 VRML 1.0 browsers will help you discern the characteristics most important to your needs and applications. Our head-to-head testing reveals the trade-off between visual faithfulness to the VRML file being



browsed and the speed with which it can be interactively navigated.

VRML 2.0 is moving rapidly to eclipse VRML 1.0-compliant products. We believe that the rendering quality, compatibilities (and incompatibilities), and browser features of a vendor's VRML 1.0 offerings will carry over to its VRML 2.0 products.

GLView (\$89) is the browser for graphics professionals who need to fine-tune the OpenGL graphics pipeline before distributing an application. While you can set render quality and effect lighting

as you can elsewhere, you can also flip object normals, try antialiasing, reverse culling, deselect edge lighting, edit vertex colors, and modify the stencil bits of pixels. GLView even supports advanced features like adding backgrounds, object geometry morphs, and fog to your scene graph. At press time, GLView supported most of the VRML 2.0 nodes for implementing morphs, fractal-based objects, and animations.

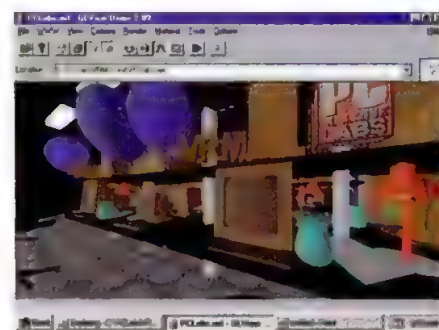
We were surprised by the absence of support for material blends with textures. Transparency was not functioning at review time, and scenes you load may inherit material properties of files previously loaded. GLView told us these two problems would be remedied. We expect that GLView will become a favorite of graphics professionals for viewing 2-D and 3-D graphics formats of all descriptions and optimizing their presentation. (EMD Enterprises, Shrewsbury, PA; 800-898-

Browse This Gallery: *A head-to-head comparison of each browser's*

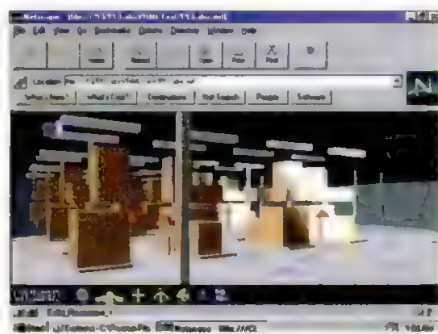
We looked at 11 VRML browsers, and the ten screenshots shown here represent how each browser rendered a view of a lab bench in our PC Labs world. (Virtus Voyager, the only VRML 1.0 browser tested that could not load our test file, is not shown.) Look for differences in color, the lighting model, missing objects, wireframe objects, and missing texture maps to decide for yourself which browser renders the scene most faithfully.

You may find that you'd like to experiment with multiple browsers or

keep more than one on hand. In order to switch between VRML browsers in Netscape, you'll need to know an undocumented trick. Only one plug-in with a name NPXXXX.DLL for each file/mime type can reside in the \plugins directory, buried deep in the directory structure, without causing ambiguity. If you rename your VRML plug-ins so that the one you want to be operative begins with NP, and rename the others so they begin with XNP, you'll have no problem.—Linda and Erick Von Schweber



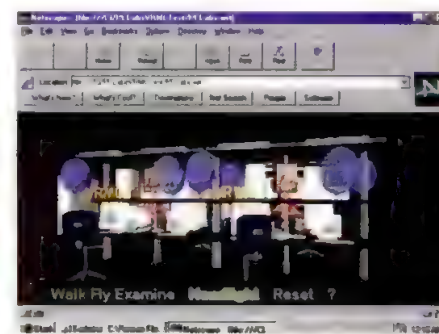
GLView supports OpenGL but lacks color blend with textures and balloon transparency; no pink lamp light fell on our sheet of paper as it should have.



Topper: A PC Labs antigravity test succeeds but vaporizes the lab benches. Topper is more a technology demo for Kinetix's tools than a full browser.



V-Realm Browser renders both lights and materials well, but the texture map is off, and the controls steal screen space.



This is VR Scout just before a crash. The contrast among the color values for the floor, ceiling, and monitors is excessive.

9363, 717-235-4423; fax, 717-227-9746; www.glview.com. *Circle 458 on reader service card.*)

Live3D (free) is the built-in VRML browser included in Netscape Navigator 3.0, and no other browser could match Live3D's frames-per-second rate (fps) without some hardware acceleration, or its ability to load and navigate every VRML file we threw at it. But to do so, Live3D optimizes the rendering of a VRML file by discarding or ignoring the lighting and material specification in the file and using its own simplified model. The visual results leave much to be desired.

Live3D scores big points for being bundled with Navigator, and it's handy to keep around for those occasional problem files that won't load in other browsers. Live3D also handles textured files exceptionally well, which will be very important when navigating the new

radiosity-rendered texture spaces (see the sidebar "VR and 3-D Players Eye the Web"). (Netscape Communications Corp., Mountain View, CA; 415-937-2555; home.netscape.com. *Circle 459 on reader service card.*)

Template Graphics Software (TGS), together with Silicon Graphics, invented the first commercial VRML Web browser, WebSpace Navigator. Now TGS is reinventing it with **3Space Explorer** (\$99). 3Space is the VRML browser recast as a COM- (Component Object Model) compliant, ActiveX component with an interface into the very innards of the VRML scene graph via 400 methods for VBScript and JavaScript. Using them, new nodes can be added to the scene graph and existing nodes altered, all while the scene graph is loaded in memory and driving the renderer.

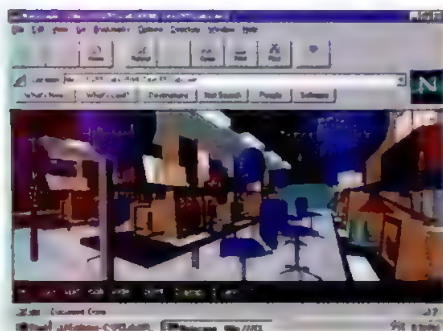
These advances have three important implications for developers and their cus-

tomers. First, 3Space becomes a totally customizable tool that empowers you to create a VRML browser today, using VBScript to give your interface the look and feel you want. Second, if you want to develop an application for more than just browsing, such as an authoring tool, 3Space delivers the promise of VRML 2.0's live modification abilities today.

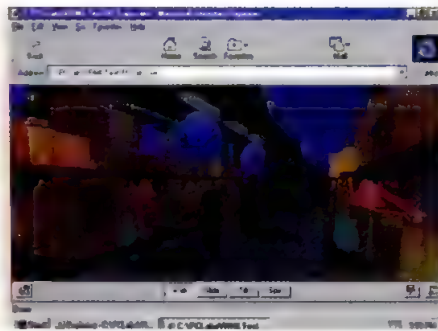
Last, 3Space can enable some applications, such as real-time data visualization, that update the scene graph in unanticipated ways based on data outside the VRML context, and beyond the scope of VRML 1.0 and 2.0.

3Space Explorer is the reinvention of the VRML browser. It will be the choice for developers seeking to tap the strengths of Microsoft's ActiveX component technology in Internet Explorer 3.0 along with the presentation capabilities of VRML. (Template Graphics Software, San Diego; 800-544-4847, 619-457-

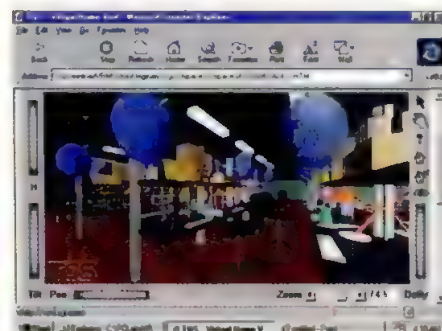
handling of color, lighting, and objects in our standard PC Magazine Labs world.



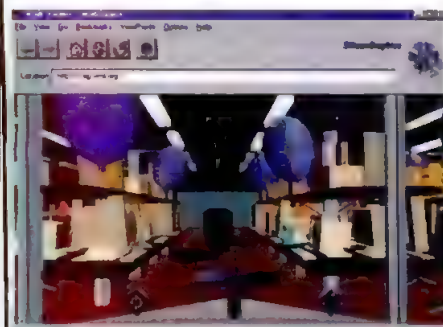
Live3D: Just repeat the words *outstanding performance* and never mind the product's less-than-ideal rendering of the world.



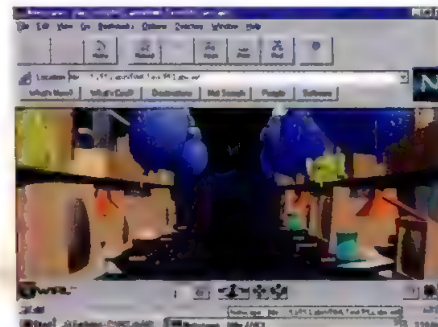
Internet Explorer has no sense of luminosity. The product textures well, but where shading should be smooth, it is coarse.



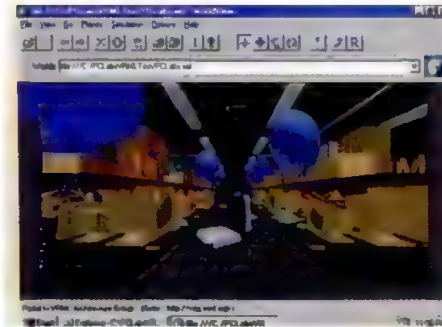
3Space Explorer gives you the pink spotlight from a desk lamp falling on paper but fails to load imported monitors files, leaving only the wireframe model.



WebSpace blends red floor with texture, makes the fluorescents emissive, and gives balloons their specular highlights. This is how VRML should look.



WRL is visually closing in on OpenGL with Direct3D. With hardware acceleration, it performed the fastest of any browser in our informal tests.



WorldView: It is similar to Internet Explorer in shading but features a stronger sense of luminance; its lighting model support is incomplete.

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PERFORMANCE TESTS

VRML World Builders and Browsers



Testing revealed plenty of performance variation among builders and browsers. The best builders create files of optimal size and logical structure that can load in any browser. Browsers should be able to render almost any world file admirably.

How We Tested

We've rated browsers in a matrix according to how well they displayed the complex PCLABS.WRL file (created using a variety of builders). We viewed each builder's VRML lab bench model using each of our reviewed browsers and rated compatibility between them.

To test VRML 1.0 conformance and visual rendering quality, we built a detailed VRML model of part of PC Magazine Labs in New York. We built this file in a variety of development environments, including the world builders we review. This world implemented all significant VRML 1.0 specification nodes, featuring multiple geometries, materials, textures, transforms, lights, cameras, Level of Detail (LOD), Inlines (external VRML resources), instances, WWW Anchors (URLs and URNs), and nesting structures (a set of nodes grouped into a higher-level object). We also imported some objects into our file. To compare rendering quality, we used MONITOR.WRL, a file provided by David Nadeau of San Diego Supercomputer Center (SDSC). We used a desk lamp and keyboard taken from *The VRML Sourcebook*, as well as TEXTURESPACE.WRL, a file provided

by Lightscape.

We assessed navigation control by using all available navigational modes to explore our test worlds. To evaluate frame-rate performance, we output the graphics card signal to a Hyperconverter 1280 from PC Video Conversion Corp. and recorded the resulting S-video signal on a high-quality VHS tape. Using the House of Immersion VRML file (URL-HOUSE.WRL) from the National Institute for Standards and Testing (NIST), we evaluated each browser as it navigated a path from the FrontPath camera to the FrontDoor camera. We tested under 640-by-480 resolution with 16-bit color, and at multiple browser speed settings where available.

We performed our browser tests on Micron Millennium 200-MHz Pentiums, each with 32MB of RAM, an ATI Mach 64 graphics card, an EIDE hard disk, and Windows 95 or Windows NT 4.0.

To participate in our roundup, products needed to run under Microsoft Windows 95, Microsoft Windows NT, or both. World builder products needed the ability to create interactive worlds suitable for the World Wide Web. Browsers needed to be able to explore a 3-D, real-time world file hosted on an HTTP server, and hyperlink from one world to another or to an HTML page.

We performed builder tests on a 90-MHz Pentium Toshiba Portégé 610CT subnotebook with 40MB of RAM, running Windows 95. Using each builder, we created a lab bench model as similar to the benches found in PCLABS.WRL as possible. We then examined the .WRL output of each builder, noting size, optimization, and readability. Each builder created the world differently, so we created a simple world made up of three 3-D primitives and three lights to enable direct comparison.—Jay Munro and Linda and Erick Von Schweber

BROWSERS

- World loaded; visual quality high
- ◐ World loaded; visual quality acceptable
- World loaded; visual quality poor
- World did not load, frequent crashes

	GLView	Live3D	Microsoft IE 3.0 VRML ActiveX Control	3Space Explorer	Topper	Virtus Voyager	V-Realm	VRScout	WebSpace Navigator	WIRL	World- View
--	--------	--------	--	--------------------	--------	-------------------	---------	---------	-----------------------	------	----------------

CROSS-COMPATIBILITY WITH BUILDERS

Ez3d VRML Author Pro 2.0	●	○	●	●	○	○	●	●	●	●	●
Pioneer Pro	○	○	○	○	○	○	○	○	○	○	○
Virtual Home Space Builder 2.0	○	●	●	○	○	○	○	○	○	○	●
Virtus 3-D Website Builder	●	◐	●	●	●	●	●	●	●	●	●
V-Realm Builder	●	○	●	●	○	◐	●	○	●	●	●

COMPATIBILITY WITH TEST FILE

PC Magazine Labs Test World	◐	◐	○	●	○	○	●	○	●	●	○
-----------------------------	---	---	---	---	---	---	---	---	---	---	---

PEAK FRAMES PER SECOND

Software-only rendering	2	11	11	5	4	5.5	5	8.5	N/A	6.3	11
-------------------------	---	----	----	---	---	-----	---	-----	-----	-----	----

N/A—Not applicable: Our test was not compatible with this browser.

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"...the Suite's full package of Net-specific features sets it apart from Microsoft Office and Lotus SmartSuite."

Computer Currents,

May 28, 1996

"Corel Office's applications rank among the most powerful on the market."

Computer Shopper,

May 1996

"Feature for feature, the new Corel suite outperforms the competitors..."

Home Office Computing,

June 1996

"Now it's Microsoft's turn to play catch-up."

InfoWorld,

March 18, 1996



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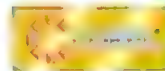
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5359; www.tgs.com. Circle 460 on reader service card.)

Autodesk invented desktop VR with its CyberSpace Development Project in the late 1980s. Now Autodesk's spinoff, Kinetix, is offering a technology demo called **Topper** (free). The software sets the stage for Kinetix's plan to use its 3D Studio Max product to create motions, animations, and movement primitives. You'll bring these animations and your VRML scene (also produced in Max; see the sidebar "VR and 3-D Players Eye the Web") into Kinetix Hyperwire, a point-and-click Java development environment. You'll then wire up your world, connecting user actions such as touching a doorknob with the animation of the door opening. Topper completes the package by letting you view the VRML 2.0 file and its Java code. Kinetix's vision will allow artists and designers to embrace the building of moving worlds. (Kinetix, a division of Autodesk Inc., San Rafael, CA; 800-879-4233, 415-507-5000; www.ktx.com. Circle 461 on reader service card.)

Virtus Voyager (free), included with Virtus's 3-D Website Builder and also

available separately, is best thought of as a convenience product, because it's not a very compliant browser. The incompatibilities we found are a good indication that Voyager will display many worlds on the Web improperly, or may simply fail to load them in the first place.

We missed the controls offered in other browsers for setting a headlight and altering rendering quality. Voyager does offer a variety of different shading models, but the results produced either no appreciable difference or visual garbage. If you're planning to view only Virtus worlds or just need a test browser for Virtus development, Voyager may take you where you want to go. (Virtus Corp., Cary, NC; 800-847-8871, 919-467-9700; www.virtus.com. Circle 444 on reader service card.)

V•Realm Browser (free) is a solid OpenGL-based VRML browser that implements the complete Open Inventor lighting and material models on which VRML 1.0 is based. V•Realm's navigation controls still feature the flight-simulator look and feel of previous incarnations, but you've got good con-

trols with which to change the camera angle and elevation, a compasslike dial you use to sweep your viewpoint horizontally, and the "scope" for navigation.

V•Realm has a rich collection of runtime parameters, from render style for both still and motion modes to gravity and collision detection. With an OpenGL accelerator engine, we experienced performance that matched the best of the Renderware/Reality Lab/Direct3D browsers, but with the impressive visual quality that only OpenGL currently delivers. If you're flying OpenGL, then log some hours with V•Realm. (Integrated Data Systems Inc., Savannah, GA; 912-236-4374; fax, 912-236-6792; www.ids-net.com. Circle 445 on reader service card.)

Chaco Communications' VRML browser, **VR Scout** (\$19.95), forms the basis for the company's Pueblo multiuser client, a separate product that links to suitably customized versions of MUD (Multi-User Domain) and MOO servers. Considering this link, VR Scout will appeal to devotees of these text-based precursors of VRML worlds.

VR Scout offers a unique streaming

SUMMARY OF FEATURES

VRML Browsers

	GLView 2.00	Live3D 1.0	Microsoft Internet Explorer 3.0 VRML ActiveX Control	3Space Explorer	Topper 1.2b	Virtus Voyager 1.0b	V•Realm Browser 1.1	VR Scout 1.40
■ YES ■ NO								
Products listed in alphabetical order								
General Features								
List price	\$89	Free	Free	\$99	Free	Free	Free	Free
Available for Windows 3.x/95/NT	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Full documentation via Help/Internet/manual	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Support via e-mail/Web/toll-free phone number	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Standalone/Netscape plug-in/IE ActiveX control	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Supports VRML 1.0/2.0 files	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Other file formats supported	.3DV	None	None	.iv	3DS, VRML	VMDL	.iv	None
Gravity/collision detection	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Controls								
Mouse shortcuts for navigation	■	■	■	■	■	■	■	■
Headlight on-and-off switch/Dimmer	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User can set background color	■	■	■	■	■	■	■	■
Virtual I/O glasses/Joystick control	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Animated path between cameras	■ ■	■	■	■	■	■	■	■
User can set motion speed/sensitivity/blur	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Rendering								
Point cloud/Wire frame	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Flat/smooth shading	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
Transparency	■	■	■	■	■	■	■	■
User can suppress texture mapping	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User can configure separately for motion	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Supports GZIP compressed files	■	■	■	■	■	■	■	■
* Using the NCompass ActiveX plug-in.								

function: As a large VRML world is downloading, Scout begins displaying the scene, constructs it before your eyes, and lets you begin navigating through the world. That feature's convenient—only if whoever built the world you're downloading planned for this feature, or else you may find objects popping up in your face as you navigate.

VR Scout's performance in terms of fps was generally good, but visual quality was lacking. We saw significant deficiencies in material support and lighting. The navigation controls never felt quite right to us, either. Overall, VR Scout is better suited to viewing 3-D visualizations of multiuser environments in Pueblo than to use as a general-purpose VRML browser. (Chaco Communications Inc., Cupertino, CA; 408-996-1115; fax, 408-665-0571; www.chaco.com. *Circle 462 on reader service card.*)

WebSpace Navigator (free), from Template Graphics Software, was the first browser to let you view and navigate through 3-D worlds on the Web. WebSpace's navigation controls are still among the best. Through its use of the

OpenGL API, it effortlessly exploits the 3D Labs Permedia accelerator board, generating adequate performance along with very high visual rendering quality, quality the non-OpenGL community is just beginning to approach.

WebSpace's support for the VRML 1.0 specification still shines. It renders materials impeccably, and it supports the OpenGL lighting model featuring specular highlights (the luster of a polished apple in a spotlight), transparency, emissivity (the glow of neon), and shininess. WebSpace also defined the headlight properly and allowed the selection of a viewpoint from a list of many. The standard set by WebSpace remains a strong force, guiding and shaping the look of cyberspace. (Template Graphics Software, San Diego; 800-544-4847, 619-457-5359; www.tgs.com. *Circle 460 on reader service card.*)

Vream's new VRML browser, **WIRL** (free), lets you view worlds constructed from just as many sources as Netscape's Live3D does, while delivering rendering quality that approaches that of an OpenGL-based browser. It also supports hardware 3-D acceleration and peripherals such as head mounts and joysticks. WIRL can plug in to both Microsoft Internet Explorer and Netscape Navigator, and emerges as the best general-purpose browser in our roundup.

No other browser tested could match WIRL's intuitive navigation controls. Changing navigation mode from walking to flying to model examination was as easy as sliding the mouse over a notch. The controls never stole screen real estate from the scene itself, as they do with other browsers.

WIRL's performance was also outstanding in our informal tests using a specification accelerator board. We saw about a 50 percent greater frame rate with the accelerator board than with software-only rendering. If you're looking for the next-generation VRML browser, look no further: WIRL is here. (Vream Inc., Chicago; 312-477-0425; fax, 312-337-5264; www.vream.com. *Circle 463 on reader service card.*)

WorldView, from Intervista Software, and its cousin, **VRML 1.0 ActiveX Control for Microsoft Internet Explorer 3.0** (both free), are the technological offspring of Tony

Parisi, a VRML 1.0 coauthor. Intervista was an early adopter of the Rendermorphics RealityLab API, a graphics engine capable of delivering decent performance without dedicated hardware (purchased by Microsoft in 1995).

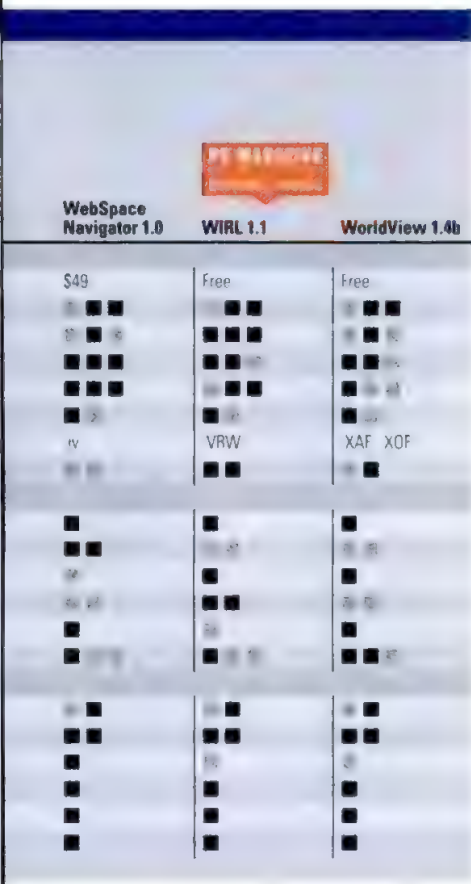
Both WorldView and Internet Explorer (IE3) produced some of the best performance numbers in our testing, and they accomplished this without degrading to the somewhat cartoonish look of Live3D. Compatibility issues did arise, however, when using them with the output of certain builder products.

The interface and navigation controls for both IE3 and WorldView are simple and effective. We preferred WorldView because of its dockable controls, which if placed near the bottom of the browser, let you shift between walk, fly, and examine modes with just a half-inch mouse movement.

Intervista will soon be announcing a VRML 2.0 offering that retains this one's excellent controls. Microsoft will be replacing its WorldView-based add-in with a new browser for VRML 2.0-compliant worlds. This new product will be based on Liquid Reality, a low-level toolkit licensed from DimensionX. In the meantime, either of these browsers may give you the performance you need without major sacrifice. (Intervista Software, San Francisco; 415-434-8765; www.intervista.com. *Circle 464 on reader service card.* Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com. *Circle 465 on reader service card.*)

All these browsers allow you to navigate through 3-D worlds on the Web by yourself. The movement toward 3-D online communities has produced a number of proprietary browsers that allow you to participate via an avatar in online chat, commerce, trade shows, and interactive adventures. The avatar world vendors are still searching for the right combination of world design, interactivity, and animation to provide, and you'll have to hope other people will be there when you arrive.

The vendors currently seeking to deliver this vision are Black Sun Interactive, Chaco, OnLive!, OZ, Sony Community, and Worlds Inc. through its AlphaWorld and forthcoming Gamma Worlds. IDS is also debuting its 3D Media Server with similar capabilities. □





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THE DEFINITIVE GUIDE TO PC TECHNOLOGIES & TOOLS

Inside the ActiveX Platform

Marketing hype aside, ActiveX is a powerful Web development paradigm with huge potential.



By Thomas Mace and Neil J. Rubenking

Microsoft got Web religion late in the game, and it heralded its conversion with a barrage of vaporware announcements. With so much attention focused on Sun's Java and on Netscape's Navigator platform, many developers have tended to discount Microsoft's offerings as so much marketing hype. They shouldn't. Many pieces of the ActiveX platform are now in place, and they add up to a compelling solution for some applications—especially intranets.

Fundamentally, the ActiveX platform is a re-adaptation of existing Microsoft technologies for the Web. The ActiveX standard rests on OLE and COM, Windows development standards that have years of history behind them. VBScript, the language used to program ActiveX objects on Web pages, is a dialect of Basic, a key language for Microsoft since the company's earliest days. The available tools used to build Web pages with ActiveX functionality owe an obvious debt to Microsoft Visual

IN THIS SECTION



TUTOR The Word macro virus known as Concept is widespread but harmless. Other macro viruses using the same techniques as Concept, however, can do plenty of damage to your system and files. Jeff Prossie explains how these macros work and what you can do to protect yourself from Concept and its more sinister siblings. *Page 277.*



POWER PROGRAMMING Dual interfaces can confer incredible speed benefits on your COM Automation objects. John Lam shows you how to combine the late-binding flexibility of an IDispatch interface with a high-performance COM interface, so that programs that only support the earlier form of COM as well as those that support the newer, faster technique can use your Automation objects. *Page 285.*



UTILITIES Explorer Notes adds a column to the Windows 95 Explorer window so that you can include a description or any other comments you like to any file entry, without taxing the operating system's file system. You can also use Explorer Notes to search on text entered in the new column. This way, you can mark files with keywords to search on groups of related files. *Page 307.*



INSIDE OS/2 IBM has given the operating system a face-lift—new desktop, Properties Notebooks, System Setup folder capabilities, Internet desktop object types, WarpCenter, and WarpGuide. Brian Proffitt shows you how these changes put OS/2 on a level playing field with competing operating systems like Windows 95 and the Macintosh OS. *Page 327.*

ALSO IN THIS ISSUE In PC Solutions, we present a clever batch file that makes use of the CHOICE.COM utility and lets you play Tic-Tac-Toe, tell you how to verify whether you have the correct display driver loaded, explain why accented characters may not transfer correctly over e-mail and how you can get around it, provide a simple way to convert integers to dates in Excel, give you a technique that can slim down huge reports in Microsoft Access, and more. *Page 349.*

Building ActiveX Controls: The State of the Tools

By Neil J. Rubenking

ActiveX controls can bring the same rich functionality to Web pages that their immediate predecessors, OLE controls, brought to RAD development tools. But ActiveX controls also raise a number of new challenges and problems for anyone who wants to write them.

Fortunately, if you jumped onto last year's bandwagon and learned to build OLE controls, your time wasn't wasted. You've got a major head start in understanding ActiveX development; ActiveX, after all, is described by Microsoft as a superset of OLE control technology. Documents about ActiveX frequently refer to OLE sources, and you'll even find phrases like "ActiveX controls, formerly known as OLE controls. . . ." in Microsoft literature.

The most significant differences in development techniques stem from the requirement that ActiveX controls be downloadable. It's also important for an ActiveX control to be able to degrade gracefully, in case the browser or other container into which it's being loaded (for example, Internet Explorer) doesn't support all of the features the control needs. At loading time, an ActiveX control should check the capabilities of the intended container and scale down to simpler behavior if a required feature isn't available.

Over the past few years, increases in system speed, available RAM, and hard disk space have encouraged a who-cares attitude toward program size. Many programmers have found that modern application frameworks and visual design tools immensely reduce the time it takes to produce attractive and full-featured programs. If the resulting program is so big it has to ship on a CD-ROM, well, CD-ROMs are cheap! The growing importance of ActiveX controls, however, will impose new discipline, driving a return to the forgotten virtues of byte-thrifty code.

Basic. By and large, this re-adaptation is a success.

This story, the third in a three-part series devoted to Web browser platforms as seen from the perspective of the developer, offers an overview of the major pieces in Microsoft's Web solution. We'll also take a look at ActiveX controls, the VBScript scripting language, the Microsoft Internet Explorer 3.0 browser—which hosts the controls—and the current state of the authoring tools used for working with ActiveX controls. Additionally, we'll look at the programming



Digital signatures assure the end user that this is your code.

EXPLORING THE OPTIONS

Every OLE control is an ActiveX control (though not every ActiveX control is an OLE control). Thus, if you're familiar with the Microsoft Foundation Classes (MFC) and have worked with the Control Developer's Kit (CDK), you already know one way to create an ActiveX control. An .OCX file created using MFC may be relatively small, but it is utterly dependent on the presence of the MFC support DLL, whose latest incarnation is nearly a megabyte in size. When a user encounters a Web page that uses a brand-new ActiveX control, there will always be a slight delay as the control is downloaded. Users may be accustomed to waiting, but that delay could stretch to 5 minutes or more when downloading the megabyte-size support DLL over a 28.8-Kbps modem. The user will blame the Web page's author, and the author will blame the control developer. That's why most ActiveX control developers are seeking solutions other than the CDK.

One such solution is the ActiveX Tem-

tools that are available for developing your own controls.

ACTIVEX CONTROLS

What are they, anyway? The simplest explanation—and one that's fully accurate as far as it goes—is that "ActiveX control" is simply the new marketing term for "OLE control" (which was the new term for "OCX control"). Any OLE control you own or have created is already an ActiveX control and can be used in ActiveX applications. OLE controls are only a subset of possible ActiveX con-

plate Library (ATL), created by the Visual C++ development team at Microsoft (see the table "For ActiveX Developers: URLs at a Glance" for the relevant URL). The ATL works within the MFC environment but produces somewhat smaller controls. For those whose only programming experience involves relying on MFC, using the ATL may be a reasonable compromise.

To create a truly tiny control, though, it's necessary to give up MFC and even abandon the C runtime library. The ActiveX Controls Framework sample code and documentation, found on Microsoft's Web site, explains how. The Web page itself is a substantial document; you'll want to save it to disk or print a hard copy. And to compile the sample code, you'll need the Microsoft ActiveX Development Kit. The sample code is clear and well commented, though still evolving. (The final version probably won't contain such comments as "/*if we're the last one, free that sucker!*/") The templates and supporting files in the ActiveX Development Kit handle many of the tedious OLE details; there's even a Control Wizard to help you set up your project. You need a basic familiarity with OLE and ActiveX, but the level of expertise required is attainable by ordinary humans.

At the other end of the spectrum is a sample control framework called BaseCtl. BaseCtl was created by the Microsoft Internet Explorer developers, and it is included in the ActiveX Development Kit. The good news is that controls built using BaseCtl will be as small as possible. The bad news is that you need the equivalent of an advanced degree in COM, OLE, and ActiveX. Consider it ActiveX for rocket scientists: Only the most dedicated and detail-minded programmers will succeed in building controls from BaseCtl alone.

What about Java? Microsoft is planning to expose Internet Explorer's Java VM as an

controls, however, and as a group, they are not necessarily the ones best suited for Web developers.

The problem with existing OLE controls is their typically large size. This is due both to the inherent complexity of the full OLE interfaces the controls must implement and to the fact that the Microsoft libraries used to create the controls were never optimized for size (to put it mildly). Because any control that's not resident on the user's system must be downloaded across the Internet before it can run, controls used on Web pages need to

ActiveX control. The company's ultimate goal is for any Java applet running in the Microsoft Java VM to be seen as an ActiveX control and to participate fully in the ActiveX environment. A number of vendors, including Borland, Microsoft, Powersoft, and Symantec, will also be providing specific tools for ActiveX control creation in their Java development systems. Thus, on the one hand, Java applets will be able to call on ActiveX control interfaces. On the other hand, Java applets will also be able to expose interfaces to the outside world, effectively becoming ActiveX controls themselves.

These aren't the only possible tools for writing ActiveX controls; conceivably, any 32-bit Windows-aware programming language could do the job. But because the ActiveX specification is still evolving, and the example code is written in C++, C++ and Java are the most likely choices.

THE ACTIVEX DEVELOPMENT KIT

As of this writing, the entire ActiveX Development Kit is still in a prerelease state, and it will continue to change for some time. Microsoft specifically states that technologies will be introduced in the ActiveX Development Kit and then

fanned out to other SDKs as the technologies become mainstream. For example, ISAPI (Internet Server API) started life in the ActiveX Development Kit.

then moved into the regular Win32 SDK. Apparently, the point is to keep the ActiveX Development Kit small and easily downloadable. As it evolves, the ActiveX Development Kit will also change to track developing versions of related products. The current beta version is tuned to Internet Explorer 3.0; the next version will focus on the beta release of Internet Explorer 4.0 (code-named Nashville).

be as small as possible. Few existing OLE controls fit the bill in this regard. Microsoft has taken two approaches to solving this problem.

One approach has been to simplify the definition of ActiveX with regard to the interfaces it must implement. An ActiveX control, technically defined, is any COM object that implements IUnknown, the basic OLE interface that provides access to all the object's other interfaces. (For details on this subject, see "OLE's Component Object Model," *PC Magazine*, November 21, 1995.)

Although ActiveX controls are the core of the ActiveX Development Kit, a number of other tools and specifications are included. Among the most important to a developer are the IMAGEHELP functions, which are used for adding digital signatures to controls, and the Internet Component Download mechanism, which lets the user verify the signature before permitting a control to be downloaded (see the screenshot for a view of the verification dialog with the certificate of authenticity). This "electronic shrink-wrap" allows a user to download your component without fear that it's been booby-trapped or infected by a virus. Internet Component Download also permits version tracking, so a newer version of your ActiveX component will automatically replace its predecessor on the user's system.

PROTECTING AUTHORS, PROTECTING PRIVACY

Another feature serves to protect you, the developer, from control thievery. Once your carefully crafted ActiveX control appears on a single Web page, it will fall into the hands of users all around the world—but unscrupulous attempts to hijack your control for a personal Web page will fail. Without a developer license, the control will

active HTML content. VBScript competes with Sun's JavaScript language. Besides the Windows and Macintosh versions, Microsoft plans to implement VBScript on the Digital, HP, IBM, and Sun platforms.

Web pages are generally public, but it's often necessary to transmit private information over the Internet. The CryptoAPI will provide system-level functions for encryption, decryption, and other cryptographic functions—meaning the application or component doesn't need to add code for those functions. In addition, certain types of encryption technology are classified as munitions by the U.S. government, which means that products using this technology have export limitations imposed on them. Applications and ActiveX controls that rely on the CryptoAPI for their cryptographic functions should have no such limitations. The CryptoAPI is supported by Windows NT 4.0 and will eventually be supported by a future release of Windows 95.

What does the future hold? More ActiveX support, certainly. At present, the only browser that supports ActiveX controls is Microsoft Internet Explorer (although an ActiveX plug-in for Netscape Navigator is available from NCompass Labs, at www.ncompasslabs.com/). Other browser vendors, with the notable exception of Netscape, are rushing to add ActiveX support, though no specific shipping dates have been announced. The ActiveX Development Kit will continue to evolve and may reach release status along with Internet Explorer 4.0. The next release of Windows NT, Version 4.0, will include DCOM, the Distributed Component Object Model. When DCOM is common, ActiveX controls should be able to interact directly with other ActiveX controls on a remote system.

Today, the entire ActiveX Development Kit is in a state of flux. If you plan to begin developing ActiveX controls, you'll want to prowel related Web sites on a regular basis for new and updated documentation. Writing controls isn't the easiest thing to do right now, but thanks to the Web, your potential audience has never been larger.

FOR ACTIVEX DEVELOPERS: URLS AT A GLANCE

To access...	go to www.microsoft.com ...
The main Internet developers' page	/intdev
The ActiveX Template Library (ATL)	/visualc/v42/at/default.htm
The ActiveX Development Kit download	/msdownload/activex.htm
ActiveX Controls Framework sample download files	/intdev/controls/ctrlfrmk1.htm
ActiveX control vendor links	/devonly/community/cbiv9.htm
The current release of Internet Explorer 3.0	/ie/iedl.htm

function only in runtime mode, not in design mode. The license feature is optional, but anyone who expects to sell more than one copy of a control will employ it.

Among the many tools related to the ActiveX Development Kit are VBScript and the CryptoAPI. VBScript, formally known as the Microsoft Visual Basic Scripting Edition, is a fast, lightweight subset of Microsoft's Visual Basic specifically aimed at providing

This makes it possible for developers to implement just a subset of the OLE interfaces needed for the task at hand, yet still be within the requirements of the specification. The other approach has been to revamp the frameworks used to develop ActiveX controls. (For a discussion of the new tools for control authoring, see the sidebar "Building ActiveX Controls: The State of the Tools.")

Although ActiveX—that is, OLE—controls are familiar to developers, they may be a new concept for some Webmasters. In essence, ActiveX controls provide a way

for a programmer to create a high-level, reusable object with some type of useful generic behavior. The programmer can then pass the control along (or sell it) to another developer, who can use it as a building block inside any programming tool that supports ActiveX controls. (Most major Windows-based tools for C/C++, Basic, Pascal, and many other languages do.) An ActiveX control could be anything from a push button to a fully functional spreadsheet. Thousands of controls are available commercially, from scores of vendors. The richness and breadth

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The ActiveX Platform

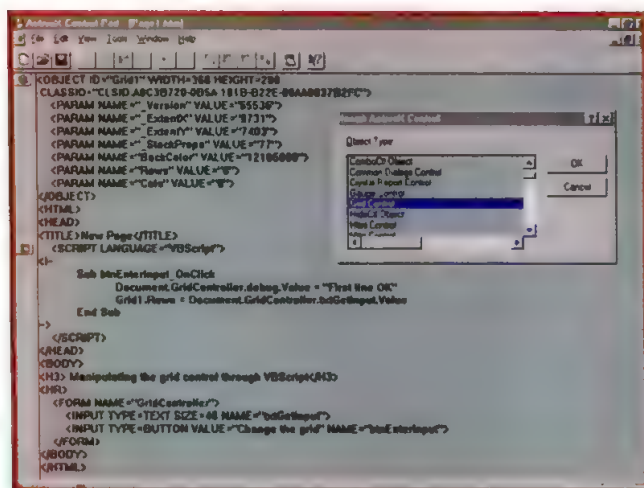


FIGURE 1: Once you've selected an ActiveX control and set its properties, ActiveX Control Pad inserts a corresponding code block in your HTML.

of these controls make up the single biggest strength of the ActiveX platform.

VBSRIPT

Microsoft Visual Basic Scripting Edition (VBScript) is the native scripting language of Microsoft Internet Explorer and the most obvious choice for programming ActiveX-based Web pages. VBScript is a Web-adapted subset of Visual Basic for Applications (VBA), Microsoft's standard Basic syntax. It uses Basic's familiar object-property dot notation, subs, functions, and flow-control structures, and it has the broad range of intrinsic functions that Basic programmers will expect. Anyone who has programmed in a modern Basic language will feel at home in VBScript.

Like VBA, VBScript supports the Option Explicit statement to force variable declaration. But unlike VBA, VBScript is not explicitly typed, and all variables, string or numeric, are stored as Variants. Implicit data types—including integer, long, single, double, string, numeric, date, and financial—exist, but the system only infers these by the format of the data. Fortunately, there are conversion functions and functions for testing the type of a variable (VarType, IsNumeric, for example) that you'll almost certainly employ for pages that implement data validation.

VBScript lacks any support for file I/O and direct memory access. This "sandbox" approach, which VBScript shares with Java and JavaScript, is necessary to prevent the language from becoming a vehicle for programs with subversive or destructive behavior. Oddly, VBScript does not support a Debug object. Overall, in fact, we found an almost total lack of debugging facilities in any of the existing tools.

Your VBScript source code is embedded into the HTML page using <SCRIPT> tags and is typically placed in the <HEAD> section of the page. The code block is prefixed by a LANGUAGE="VBScript" statement that tells

the browser which language to execute (Internet Explorer 3.0 can also execute JavaScript). You should embed your code in comment tags (<!--, -->) so that it will not display in browsers that don't support VBScript.

As tempting as it is to dive right into page construction using ActiveX controls, it's worth noting that VBScript can manipulate HTML form objects like text boxes and buttons. Even with these simple ingredients, you can build a wide range of useful functionality into the

page. VBScript calls the HTML form objects by referencing the FORM NAME and the NAME property of each object within the form.

ActiveX controls offer substantially more power than HTML forms, however. Controls are added to code using <OBJECT> tags. The code specifies the object's ID, which is the object name referenced in your code, and a CLSID, which is the 128-bit globally unique identifier (GUID) for the OLE control. When an ActiveX control is called from VBScript, the system searches the Windows Registry to see if the control is present. If not, the system uses the CODEBASE attribute (specified in the <OBJECT> tag), which points to the server contain-

sions), is a slick, feature-rich browser that is clearly making inroads on the market share of its primary competitor, Netscape Navigator. Internet Explorer has three particularly important features for developers: It can act as a container for ActiveX controls, it can execute VBScript or JavaScript scripts embedded in HTML documents, and it provides a Java virtual machine (VM) for executing Java programs.

Two additional features, though incomplete (or at least undocumented) at press time, should prove significant once they are released. The first is that Internet Explorer's Java VM itself will be exposed to the developer as an ActiveX control. This would let you launch a Java program programmatically, for example. The second is that Internet Explorer will be able to wrapper Java applets as ActiveX controls so that the applets' methods and properties become accessible to VBScript and other supported scripting languages. Internet Explorer also implements Microsoft's Authenticode feature, which allows control vendors to provide a digital authenticity signature for their controls and gives end users a basis on which to enable or deny the installation of controls during a download.

ACTIVEX CONTROL PAD

It takes nothing more than a text editor to create pages using VBScript and ActiveX controls, but you'd find yourself facing a lot of verbose and repetitive coding. Microsoft's ActiveX Control Pad, an authoring tool currently in beta and available

for free download, offers a far better solution. Compared with mature tools like Visual Basic, the ActiveX Control Pad is rough and ready and lacks such basic amenities as debugging and context-sensitive syntax help. It also introduces some new programming paradigms aimed at nonprogrammers that, in this prerelease version at least, are confusing and poorly designed. But until something better comes along, it's well worth using nonetheless.

The basic ActiveX Control Pad interface is a single text-editing window that

shows the full HTML source code of the page you're working on (Figure 1). A column on the left-hand side of the editing window displays icons to show you the position of any controls, scripts, or layouts embedded in the HTML code. The Control Pad will generate a bare HTML skeleton for new pages or let

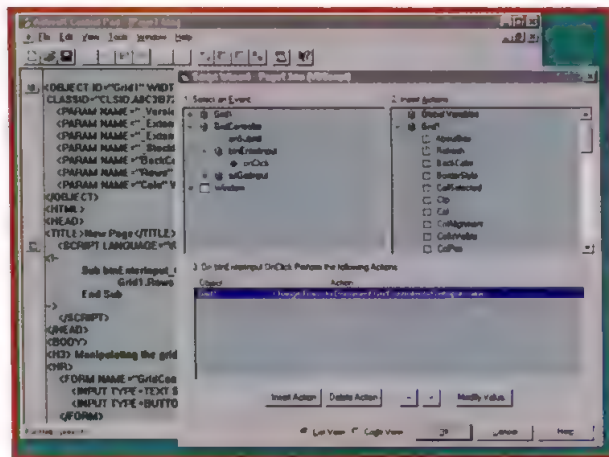
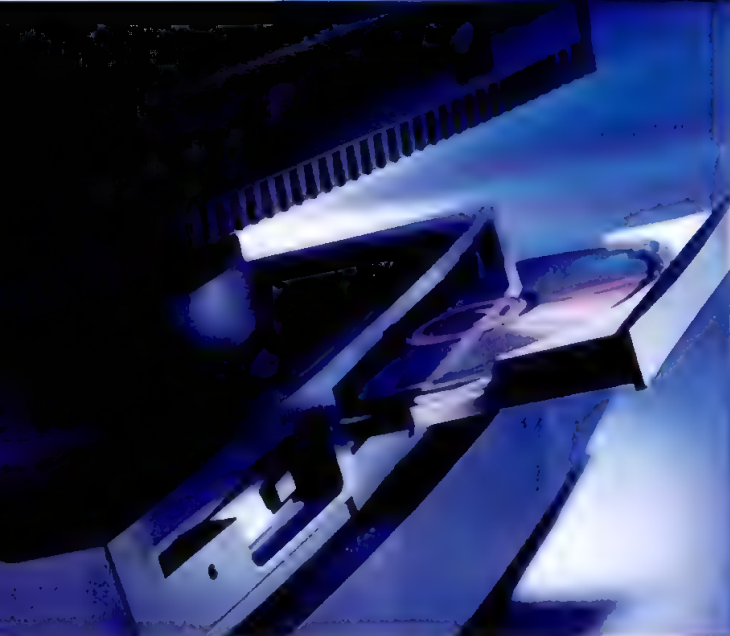


FIGURE 2: With its confusing tree view of objects, methods, properties, events, and procedures, ActiveX Control Pad's Script Wizard will probably be more confusing than beneficial for nonprogrammers.

ing the required control. After the control is downloaded and installed through an intrinsic system service, it is ready for execution.

INTERNET EXPLORER 3.0

Microsoft Internet Explorer (which we tested in the beta 1 release with Java exten-



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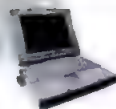
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PC Tech/Tutor

By Jeff Prosize

Beware the Word Macro Virus

How it works, how to detect it, and how to protect yourself from it.

Well, it finally happened. After 13 years of virus-free personal computing, I had my first run-in with a computer virus. Traditionally, PC viruses have fallen into one of two categories: .EXE viruses, which spread when an infected .EXE file is executed, and boot-sector/partition-table viruses, which spread when the computer is booted with an infected disk in the boot drive. I've always been careful to check .EXE files before I run them, and I avoid leaving floppy disks in the boot drive—especially ones I didn't format myself. But the virus that finally got me came from an unexpected source: a Word for Windows .DOC file.

It has long been known that Word Basic could be used to write a virus that infects document files by converting documents to templates and tacking on AutoRun macros that replicate the virus when a document is opened or saved. And I suppose it was just a matter of time before some maladjusted individual created one. But that doesn't make an attack any easier to swallow. The good news is that the virus that infected my PC, which belongs to a family of viruses known as Word macro viruses, is relatively harmless. The bad news is that there are other, more lethal strains of the Word macro virus that can do lasting harm to your data by wiping out files and configuration settings. Similar viruses now exist for Excel, as well.

Forewarned is forearmed: If you're a Word user, you need to know about the Word macro virus. Here's the scoop on what it is, how it works, how to detect it, and what to do when it strikes.

THE WORD MACRO VIRUS REVEALED

To date, about 20 different strains of the Word macro virus have been identified. The table on the right lists eight of the most common ones. The strain that seems to pop up the most often—and the one that attacked my system—is the Concept macro virus. Also known as WinWord.Concept, WW6Macro, WW6Infector, and Prank, the Concept macro virus is self-replicating and will spread to any .DOC file that's saved with the Save As command in Word's File menu. All you have to do to catch it is open an infected document;

the virus will then infect new Word documents the moment they're saved. It will also infect existing documents if you save them with the Save As command.

No one knows where the Concept macro virus originated, but apparently Microsoft was an unwitting partner in its distribution. Published reports indicate that copies of the virus were found on a Microsoft CD called The Microsoft Office 95 and Windows 95 Business Guide. The virus works by adding an AutoOpen macro to the documents it infects. When you open an infected document, AutoOpen copies four other macros to Word's global document template. One of them, FileSaveAs, replicates the virus by attaching the AutoOpen macro to all subsequent documents saved with the Save As command. Another macro, Payload, is apparently intended to include Word Basic commands that do harm to your PC. Payload contains a do-nothing REM statement in most versions of the Concept macro virus, but there's nothing to prevent someone with even a rudimentary knowledge of Word Basic from adding more malicious commands.

Many Word macro viruses store their macros in unencrypted form, so you can view them with Word's built-in macro editor. AutoOpen does nothing if the Payload macro already exists, which is a pretty reliable indicator that the document is already infected. It also returns without doing anything if there's already a FileSaveAs macro defined. Apparently the author of the virus felt that

replacing the existing FileSaveAs macro was too much trouble.

If both tests prove negative, AutoOpen adds the virus macros to the global document template (by default, Normal.dot), effectively infecting Word itself. Then, when you invoke the File | Save As command, the FileSaveAs macro copies the illicit AutoOpen macro and other macros used by the virus to your saved document.

An interesting aside to this discussion is that since the virus steers clear of the global document template if a Payload macro is already defined, an easy way to vaccinate Word against the Concept macro virus is to add a do-nothing macro named Payload to your Normal.dot template. That won't protect you from all macro viruses, but it will stop the Concept virus in its tracks.

DETECTING AND KILLING THE VIRUS

How do you know whether a Word document is infected with the Concept macro virus? When you open an infected document, the virus displays a message box with the number 1 in it (see Figure 1). The AutoOpen code contains a MsgBox statement that displays the message box. You can also determine whether a document is infected by checking for the tell-tale macros. With the document loaded, pull down Word's Tools menu, select Macro, and look for macros named AAAZAO, AAAZFS, AutoOpen, and Payload. If the macros are there, then the document is infected.

You can tell if Word itself has been infected

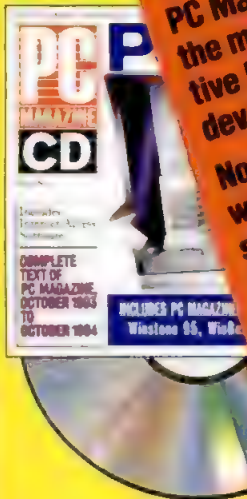
COMMON WORD MACRO VIRUSES

Virus name	Macros used	Harmful effects
Atom	Atom, AutoOpen, FileOpen, FileSaveAs	On December 13, deletes all files in the current directory.
Colors	AutoExec, AutoLoad, AutoOpen, FileExit, FileNew, FileSave, FileSaveAs, ToolsMacro	Randomly changes the screen colors in WIN.INI the 300th time the virus is executed.
Concept	AAAZAO, AAAZFS, AutoOpen, FileSaveAs, Payload	None.
Demonstration	AutoClose	None.
FormatC	AutoOpen	Attempts to format the C: drive.
Hot	AutoOpen, FileSave, InsertPageBreak, StartOfDoc	After 14 days, deletes the contents of the document to which it is attached
Nuclear	AutoExec, AutoOpen, DropSurviv, FileExit, FilePrint, FilePrintDefault, FileSaveAs, InsertPayload, Payload	Appends "Stop all French nuclear testing in the Pacific" to printed documents. Also deletes selected system files on a designated date (usually April 5).
Wazzu	AutoOpen	Randomly moves words in the document. Also randomly inserts the word Wazzu.

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by the Concept macro virus by checking the macros attached to the global document template. Just open any document and select Tools | Macro. Then select Normal.dot in the Macros Available In box. If the list of macros includes AAAZAO, AAAZFS, FileSaveAs, and Payload, as shown in Figure 2, then Word is infected. Unless you eradicate the virus, every new document you save and every existing document you load and save under another name will become a carrier of the virus.

Checking the list of macro names associated with a document or document template is also an effective method of detecting a less common but more sinister strain of the Word macro virus. If a document contains macros named Payload and DropSurviv, there's a very good chance it's infected with the Nuclear macro virus. Unfortunately, other strains of the virus aren't as easily detected by their macro names. The best way to guard against these viruses is to use a virus-checking utility. Most commercial virus checkers will now detect Word macro viruses and cleanse infected documents.

If you discover that Word is infected with the Concept macro virus but don't have a virus killer handy, you can remove the virus yourself by deleting the AAAZAO, AAAZFS, FileSaveAs, and Payload macros from Normal.dot. Deleting a macro is easy: Select the macro in Word's Macro dialog and click on the dialog's Delete button.

After you've cleansed Word, you should check your .DOC files to find out where the virus came from. You can cleanse an infected document by deleting its AAAZAO, AAAZFS, AutoOpen, and Payload macros (from the document, not from the global document

template). After you've disinfected the document, you'll need to disinfect Word again, because the act of opening the document re-infects the global document template.

If your hard disk contains hundreds of .DOC files, it's tedious to root out macro viruses by opening each document one by one. An easier way to defend against the Word macro virus is to download the Macro Virus Protection tool—a self-extracting archive named

Mvtool40.exe—from Microsoft's Web site at www.microsoft.com/msword/freestuff/mvtool/mvtool2.htm. One of the files in the toolkit is a document named Scanprot.doc, which installs a set of protective macros that warn you when the document you're about to open contains macros of its own—a possible sign that the document is infected. It also offers to scan your hard disk for instances of the Concept macro virus and

cleanse documents that are infected with it. If you don't have access to the Web, you can get a copy of the toolkit by calling 206-462-9673 or sending e-mail to wordinfo@microsoft.com.

Although the toolkit's early warning system will give you a heads-up when a document infected with any strain of the Word macro virus is loaded, it's not foolproof. After all, many virus-free .DOC files contain macros, and the toolkit doesn't discriminate between good macros and bad ones. In addition, the toolkit doesn't detect non-Concept strains of the Word macro virus. The best way to protect yourself against all known strains and make eradication simple is to invest in a virus checker that will detect and kill the Word macro virus, such as Symantec's Norton AntiVirus.

FURTHER INFORMATION

There are several Web sites where you can obtain additional information about macro viruses that affect Word and Excel. The best all around is the Macro Virus Information page (part of Symantec's Antivirus Research Center on the Web) at www.symantec.com/avcenter/wmacrom.html. For information on the Laroux macro virus, which infects Excel spreadsheets, visit www.symantec.com/avcenter/xmlaroux.html.

Macro viruses are no laughing matter, whether they're harmful or not. Be on your guard against them, and maybe you won't be surprised, as I was. Luckily, no real harm was done. But with new and more damaging strains of the Word macro virus appearing regularly, luck may not be enough the next time. □

Jeff Prossie is a contributing editor of PC Magazine.

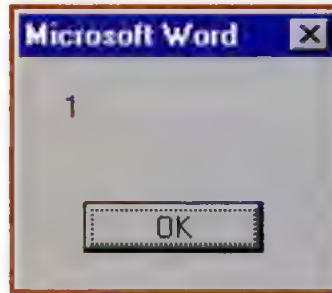


FIGURE 1: Surprise! The document you just opened is infected with the Concept macro virus.

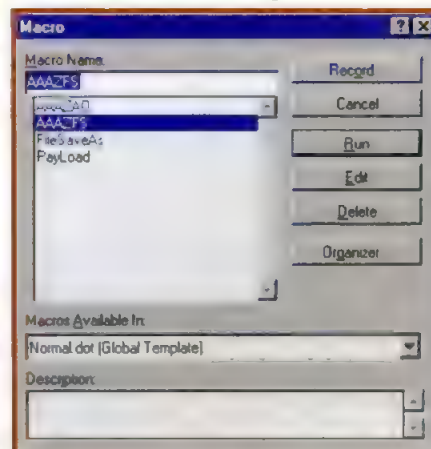


FIGURE 2: Word's Macro dialog, with evidence that NORMAL.DOT has been infected with the Concept macro virus.



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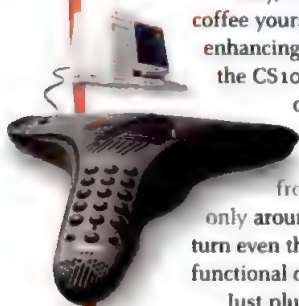
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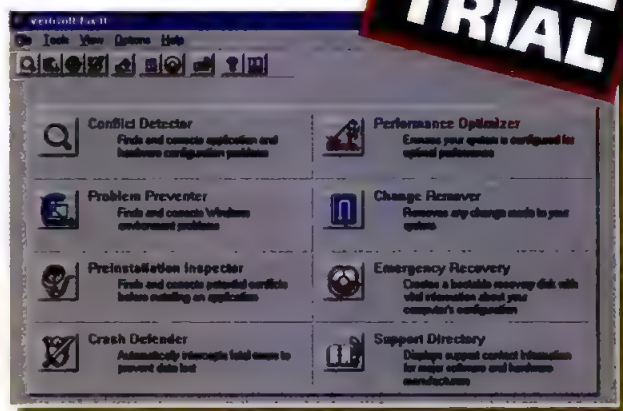


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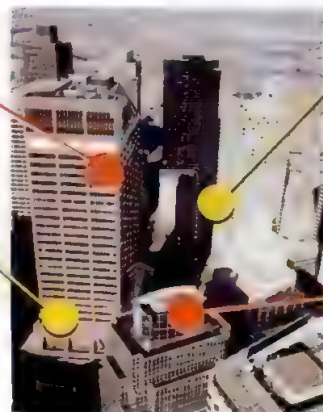
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Concord	94030	8000	Alameda	12/95	Business	3557 4th St	CA	925-355-7000	1.2 mi E
Concord	94030	8000	Alameda	12/95	Business	3557 4th St	CA	925-355-7000	1.2 mi E
Concord	94030	8000	Alameda	12/95	Business	3557 4th St	CA	925-355-7000	1.2 mi E
Concord	94030	8000	Alameda	12/95	Business	3557 4th St	CA	925-355-7000	1.2 mi E

Address Field
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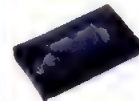
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By John Lam

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Combine IDispatch's flexibility with high-performance COM.

Previous installments of this column looked at Automation—previously known as OLE Automation—and Automation Collections (in our issues of March 12, 1996, and April 9, 1996, respectively). To keep things simple in those columns, we looked at a rather pedestrian form of Automation, the kind that involves invoking functions through Automation's IDispatch interface. This time, we'll tackle the hot rod of Automation interfaces: the *dual* interface.

A dual interface combines the late-binding flexibility of an IDispatch interface with a high-performance COM interface. Code that understands how to call your functions using the dual interface will get much higher performance: depending on the types of parameters being passed, up to 500 times that of calling the same function through an IDispatch interface! Yet a dual interface also retains the IDispatch interface's flexibility, so legacy code can continue to use your Automation object. We'll show how, with a little bit of extra effort, you can add dual-interface support to your Delphi 2.0 Automation objects.

You can download all of the source code mentioned in this article from PC Magazine Online. (For downloading instructions, see the sidebar "Guide to Our Utilities" in this issue's Utilities column.)

A QUICK REVIEW OF AUTOMATION

Automation came about because of the need to share code libraries. By using the Windows dynamic link library (DLL) mechanism and distributed .lib and .h files, developers could link DLLs to their code. For that mechanism to work, however, a compiler must generate code to resolve the addresses of library functions at runtime. That means developers must recompile their applications when they incorporate your library into them. Furthermore, every time you change your library, every application that uses it must be recompiled too.

The compilation step could be eliminated by defining a standard way for code libraries to talk to one another. The standard would have to define a naming convention for exported functions. It must also define a set

of data types that all functions can understand. Finally, it must define a binary description of the functions and data types exported by a code library, so that applications can resolve the addresses of a library's functions at runtime. These are the standards defined by Automation.

Automation is built on top of COM (Component Object Model), which was implemented by Microsoft as a generic solution to the problem of getting objects to communicate with each other. It has been widely adopt-

ed by COM objects communicate with each other through *interfaces*. A COM interface represents a group of related functions exported by a COM object. How does an interface "represent" a group of functions? Through a table. A COM interface is a table of pointers (known as a *vtable*) to the functions implemented by the COM object. The way you call the interface's member functions is the same for all types of COM objects, whether in-process or out-of-process, so that you need to be concerned with only the nature of the functions

you're calling, and not *how* the functions are invoked. COM takes care of the details, and that greatly simplifies the programming model.

Every COM object must support the IUnknown interface, which has three member functions. QueryInterface allows a calling object or program to determine whether a COM object supports another interface, and AddRef and Release keep track of how many other objects are referencing the object and, ultimately, control an object's lifetime. Each call to AddRef increments a reference count, and

each call to Release decrements it. When the count reaches zero, the object can safely be destroyed.

THE IDISPATCH INTERFACE

The designers of Automation wanted to create a way of calling functions without even needing to know their names at compile-time. This is known as *late binding*. During runtime, the function names are resolved through an interface called IDispatch.

IDispatch is a COM interface that has seven member functions. The first three are the member functions of the IUnknown interface. The last four are the ones in which we're interested here. Two of them, GetTypeInfo and GetTypeInfoCount, are related to type libraries, which we'll discuss later. The heart of IDispatch resides in the other two functions, Invoke and GetIDsOfNames.

In the simplest case, an Automation controller will create an instance of your COM object at runtime but doesn't know what functions the object supports. When it wants to know whether the COM object supports a

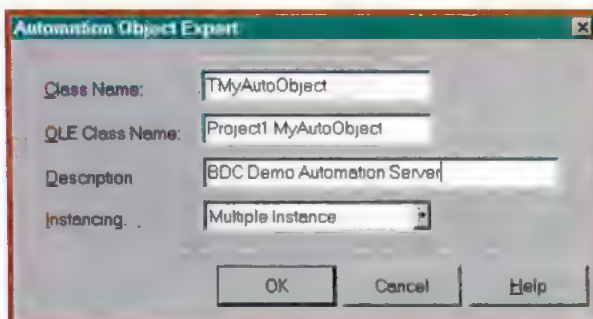


FIGURE 1: Delphi 2.0's Object Repository lets you create new applications, dynamic link libraries, and Automation objects.

ed by the Windows software development community, largely because it does not lock a developer into any single development tool or language. You can create COM objects using Visual Basic, Delphi, or C++, although Delphi and C++ developers do have an advantage over programmers who use other languages, as we will see.

TYPES OF COM OBJECTS

There are three classes of COM objects: in-process, local, and remote. In-process COM objects reside in the process space of the application that invokes them and are implemented as DLLs. Local COM objects reside in their own process space and are typically implemented as executable files. Remote COM objects reside on another computer and may be implemented as either DLLs or executable files. Support for remote COM objects will be provided by the Distributed COM libraries that will be released as part of Windows NT 4.0 and a future upgrade to Windows 95. We will be concerned here primarily with in-process COM objects.

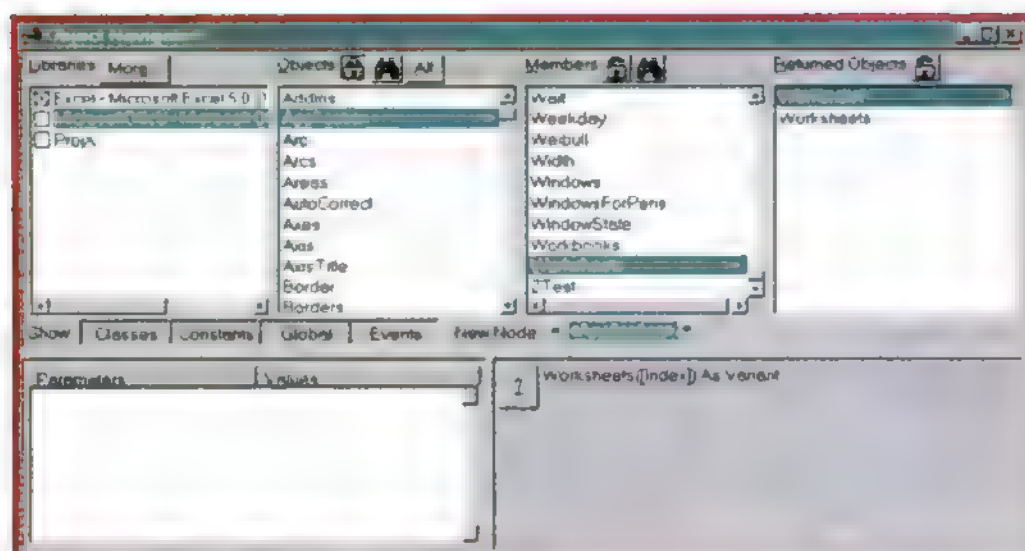


FIGURE 2: *Object Navigator is a type-library browser that makes it easy to explore the capabilities of any Automation object described by a type library (such as Excel's, shown here).*

given function, it calls the `GetIDsOfNames` function, passing it a string that contains the name of the function in which it is interested. If your object supports a function with that name, it returns a Dispatch ID, or `DispID`, to the Automation controller, which then uses that `DispID` to call the object's `Invoke` function, along with any parameters it needs to pass to the function.

How does the Automation controller know what parameters your function takes? A smart controller will find out by reading your COM object's type library (explained later in this article). If no type library is available or if the controller doesn't read type libraries, it cannot know what parameters are correct. The programmer working with the controller is responsible for specifying the correct parameter list based on the documentation supplied by the creator of the COM object. The controller constructs an array of parameters based on the programmer's list and passes the array to the COM object. Each element of the array includes type information, so when the COM object receives the array it can determine the actual types of the passed parameters.

The elements of this parameter array are composed of *Variants*, which are defined by the Automation specification. Variants should sound familiar, since they're a common data type in Visual Basic. A Variant is a 16-byte packet of data defined as a union of many familiar data types. Most Variant data types are passed by value; the data is contained entirely within the Variant itself. A notable exception, however, is strings. Automation strings are known as Basic strings, or BSTRs. A BSTR is a hybrid of

a Pascal string and a C-style, null-terminated string. Its Pascal-style stored length provides fast concatenation and lookup speed, while its terminating null character means it can be passed to API functions that require a null-terminated string.

DUAL INTERFACES

As mentioned earlier, an `IDispatch` interface contains seven functions. In a dual interface, you provide

entries for your Automation functions, beginning at entry 8 in the `IDispatch` vtable. A COM object's vtable has the same layout as a C++ vtable does, which is also the same as that of a Delphi virtual method table. So all you have to do is derive a new class from `IDispatch` and implement the Automation object's functions as virtual functions.

With Delphi 2.0, you can create both Automation controllers and Automation servers. You can use Delphi to control an Automation object simply by declaring a Variant variable and calling the `CreateOleObject` function defined in `oleauto.pas`:

```
uses OleAuto;
...
var
  WordObject: variant;
begin
```

```
WordObject :=
  CreateOleObject('Word.Basic');
...
WordObject.FileNewDefault;
```

Creating an Automation server is just as easy. Simply derive your new class from `TAutoObject`:

```
uses OleAuto;
...
type
  TMyAutoServer = class(TAutoObject)
  ...
  automated
  procedure Foo;
  ...
end;
```

As you can see, it is quite straightforward to create both Automation controllers and Automation servers using Delphi. But since the focus of this article is on creating Automation servers, let's quickly take a tour of the features that make doing this easy in Delphi.

A SIMPLE AUTOMATION OBJECT

The first thing you must decide when creating an Automation server is how to package it. In its simplest form, an Automation server is simply a code library. In stark contrast to the pre-Automation days of Windows programming, Automation allows you to share libraries of code in either DLLs or executable files. The way in which you build and call the Automation object is identical in both cases: You only have to choose which kind of project to create. We'll create an example Automation server packaged in a DLL.

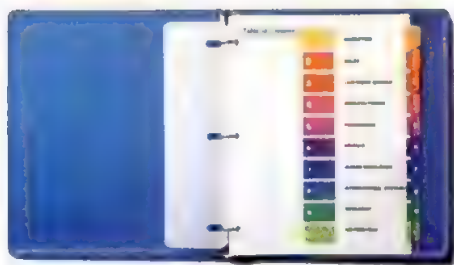
You create a new DLL project by selecting the DLL Expert from the New page of Delphi's Object Repository. First, edit the project (.DPR) file. Add the unit `OleAuto` to the `uses` clause, and add the following line of code to export the functions implemented in `oleauto.pas`:

```
exports
 DllGetClassObject,
  DllCanUnloadNow,
  DllRegisterServer,
  DllUnregisterServer;
```

Those four functions are all implemented for you in `oleauto.pas`. The `DllRegisterServer` and `DllUnregisterServer` functions register and unregister your Automation server with the Windows 95 Registry. `DllGetClassObject`, a

```
TAutoObject = class(TObject)
private
  FRefCount: Integer;
  FAutoDispatch: TAutoDispatch;
  function GetIDsOfNames(Names: POleStrList; Count: Integer;
    DispIDs: PDispIDList): HRESULT;
  function GetOleObject: Variant;
  function Invoke(DispID: TDispID; Flags: Integer; var
    Params: TDispParams;
    VarResult: PVariant; ExceptInfo: PExceptInfo; ArgErr:
    PInteger): HRESULT;
  procedure InvokeMethod(AutoEntry, Args, Result: Pointer);
  function QueryInterface(const iid: TIID; var obj): HRESULT;
protected
  procedure GetExceptionInfo(ExceptObject: TObject;
    var ExceptInfo: TExceptInfo); virtual;
public
  constructor Create; virtual;
  destructor Destroy; override;
  function AddRef: Integer;
  function Release: Integer;
  property AutoDispatch: TAutoDispatch read FAutoDispatch;
  property OleObject: Variant read GetOleObject;
  property RefCount: Integer read FRefCount;
end;
```

FIGURE 3: *The declaration of TAutoObject.*



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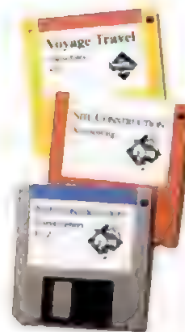
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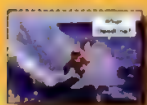
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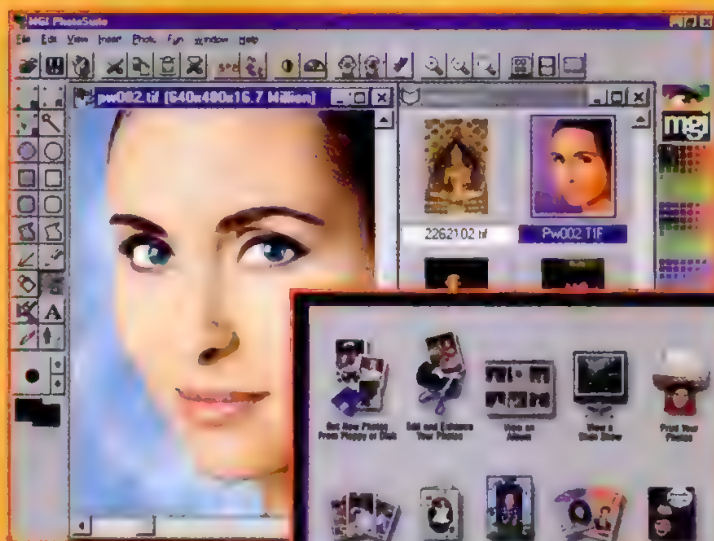
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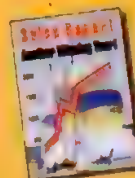
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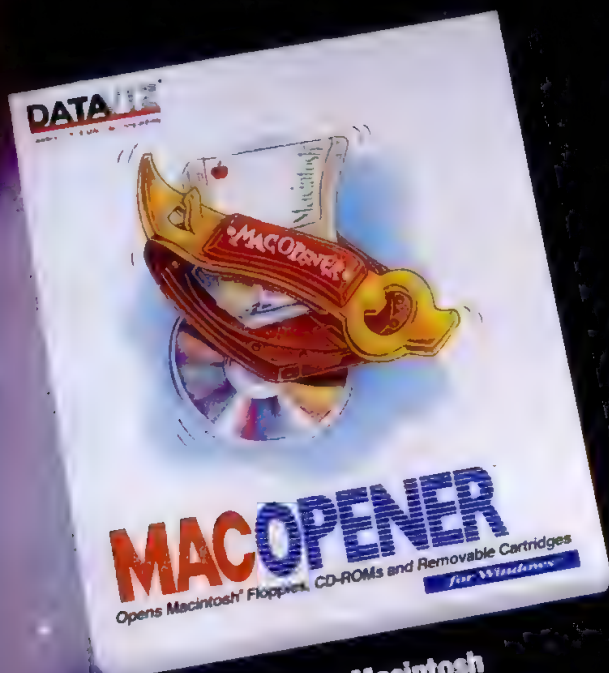
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```
TAutoDispatch = class(IDispatch)
private
    FAutoObject: TAutoObject;
public
    constructor Create(AutoObject: TAutoObject);
    function QueryInterface(const iid: TIID; var obj): HRESULT; override;
    function AddRef: Longint; override;
    function Release: Longint; override;
    function GetTypeInfoCount(var ctinfo: Integer): HRESULT; override;
    function GetTypeInfo(itinfo: Integer; lcid: TLCID;
        var tinfo: ITypeInfo): HRESULT; override;
    function GetIDsOfNames(const iid: TIID; rgszNames: POleStrList;
        cNames: Integer; lcid: TLCID; rgdispID: PDispIDList): HRESULT;
        override;
    function Invoke(dispatchIDMember: TDispID; const iid: TIID; lcid: TLCID;
        flags: Word; var dispParams: TDispParams; var Result: PVariant;
        excepInfo: PExcepInfo; argErr: PInteger): HRESULT; override;
    function GetAutoObject: TAutoObject; virtual; stdcall;
end;
```

FIGURE 4: The declaration of *TAutoDispatch*.

standard entry point for all COM objects, is used by the COM libraries to create new instances of a COM object implemented by the DLL. *DllCanUnloadNow* is called by the COM libraries to determine whether it can unload the DLL.

Once we have set up the DLL's project file, we can turn our attention to creating the actual Automation object. Bring up Delphi's Object Repository again, but this time select the Automation Object Expert (Figure 1) from the New page. In the Class Name field, type in the name of the class that will be your Automation object. For this example, type in *TMyAutoObject*. You'll notice that Delphi fills in the OLE Class Name field for you with the name of your project followed by the name of your Automation object's class, but without the "T" prefix. Type any description you like in the Description field. Don't bother with the Instancing options in this case, as DLL-based Automation objects are always Multiple Instance.

After you click on OK, Delphi will create a new unit for you. Let's take a quick look at the generated code:

```
unit Unit1;
interface
uses
    OleAuto;
```

There will be a reference to the *OleAuto* unit in every Automation unit. We'll take a closer look at *oleauto.pas* when we start building a dual-interface Automation object.

```
type
    TMyAutoObject = class(TAutoObject)
```

Here, we're deriving a new class from *TAutoObject*, the base class for all Automation objects you create using Delphi. Among other things, *TAutoObject* contains a nested class

that implements the *IDispatch* interface required for Automation support.

```
private
    { Private declarations }
automated
    { Automated declarations }
end;
```

In this section, note the new *automated* keyword. All function, procedure, and property declarations in this section will be exposed as Automation methods and properties. Delphi's compiler generates tables that describe the function names and their parameter types, so that calling applications can bind to these methods in a type-safe manner.

```
implementation
procedure RegisterMyAutoObject;
const
    AutoClassInfo: TAutoClassInfo = (
        AutoClass: TMyAutoObject;
        ProgID: 'Project1.MyAutoObject';
        ClassID: '{76D47E00-B0AA-11CF-
            896C-444553540000}';
        Description: 'BDC Demo Automation
            Server';
        Instancing: acMultiInstance);
begin
    Automation
        .RegisterClass(AutoClass Info);
end;
```

The Automation Expert automatically generates code to fill in the *AutoClassInfo* structure. Most of the information entered in the Automation Expert appears in the fields of *AutoClassInfo*. There is, however, one additional field that's extremely important: the *ClassID* field. Delphi uses a COM library function called *CoCreateGuid* to generate this number for you. *CoCreateGuid* uses an

algorithm that generates a unique GUID (Globally Unique Identifier) from a combination of highly variable machine states and your network card's Ethernet address.

```
initialization
    RegisterMyAutoObject;
end.
```

When the unit is initialized for the first time, Delphi calls the *RegisterMyAutoObject* function. Delphi needs to initialize a number of internal data structures that track all of the Automation objects exported from the DLL (or executable file, in the case of a local server).

WHAT DELPHI LACKS

As you can see, Delphi provides a very easy mechanism for building and creating Automation servers. But one shortcoming makes it difficult for you to build dual-interface Automation servers: Delphi does not automatically create type libraries for you, and without a type library, the Automation controller doesn't know what parameters to use in calling your dual-interface functions directly.

That doesn't make creating dual-interface Automation servers with Delphi impossible, but it does require you to take additional administrative steps in order to build a type library. Those steps are time-consuming and error-prone, so it would be nice to see some enterprising third-party developer create tools to automate the process.

Automation objects, you'll recall, use the *IDispatch* interface to facilitate late binding, which frees applications from the responsibility of knowing, at compile-time, the methods and property names of the Automation objects with which they wish to communicate. However, the same flexibility also makes it difficult for the developer building the application to discover what the capabilities of an Automation object are. Ideally, if the Automation object you want to use was purchased from a third-party developer, it would have been accompanied by comprehensive documentation. Still, it would be nice to be able to browse the methods and properties of an Automation object without having to reach for that big, heavy book. And that's where type libraries come in.

Type libraries can be used by both computers and humans. You and I wouldn't want to view a type library in its binary file format, but several useful type-library browsers are available. Figure 2 shows a partial excerpt of the type library for Microsoft Excel 7.0, as seen from Matt Curland's Object Navigator browser (available in *Object Programming with Visual Basic 4.0*, from Microsoft Press).

Type libraries can be exploited by Automation controllers, too. That's especially important when the Automation object resides in a different process space than the calling application does. An intelligent Automation

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controller can prebind to an Automation object's type library in a single step. It is far more efficient to read in an Automation object's entire type library once than it is to call the object's `GetIDsOfNames` function repeatedly across a process boundary every time you wish to call a new function.

Perhaps even more important to us, however, is how a type library relates to dual interfaces. As we mentioned earlier, a dual interface is a combination of an `IDispatch` interface and a custom COM interface. The first seven member functions are the `IDispatch` and `IUnknown` member functions, and all subsequent member functions are the dual interface's. So how, you might ask, does an Automation controller determine which entry in the vtable corresponds to which function? Through the type library, of course.

A type library provides other benefits to the Automation controller. It lists the types of all parameters that are to be passed to a given function, allowing an Automation controller that prebinds to a type library to determine at compile-time whether any arguments passed are correct, and putting some of the advantages of strong typing into your applications.

By using the information contained in the type library, an Automation controller that supports dual interfaces can push the correct parameter types onto the stack before calling the Automation function. That's very important—undesirable things will happen if the automation function starts pulling parameters of unexpected types off the stack! Note that this is quite different from calling functions through the `IDispatch` interface's `Invoke` function, where an array of `Variants` must be generated prior to calling the `Invoke` function.

ODL FILES

Just how do you create a type library? Microsoft ships a tool called `Mktyplib.exe` with the Win32 SDK and the OLE SDK. `Mktyplib` reads ODL (Object Definition Language) files and builds a binary type-library file for you. If you've done RPC (remote procedure call) programming, you've used a similar tool, `MIDL`, which reads IDL (Interface Definition Language) files and compiles them into C source code for COM and RPC bindings. Interestingly, there's very little difference between ODL and IDL files. In the Windows NT 4.0 Beta 1 SDK, you'll find a new version of `MIDL` (Version 3.0) that will compile IDL files into type-library files, too. In the future, we're going to see a gradual disappearance of ODL files, since they do little else than provide the definition for a type library.

Let's look at the ODL file I used to create our sample dual-interface Automation object:

```
// Project1.odl : type library source
// for Project1.dll
// This file will be processed by
```

```
TAutoDispatch = class(IDispatch)
protected
    // *** PROMOTED to PROTECTED!
    FAutoObject: TAutoObject;
public
    constructor Create(AutoObject: TAutoObject);
    function QueryInterface(const iid: TIID; var obj): HRESULT; override;
    function AddRef: Longint; override;
    function Release: Longint; override;
    function GetTypeInfoCount(var ctinfo: Integer): HRESULT; override;
    function GetTypeInfo(itinfo: Integer; lcid: TLCID;
        var tinfo: ITypeInfo): HRESULT; override;
    function GetIDsOfNames(const iid: TIID; rgszNames: POleStrList;
        cNames: Integer; lcid: TLCID; rgdispid: PDispIDList): HRESULT;
        override;
    function Invoke(dispidMember: TDispID; const iid: TIID; lcid: TLCID;
        flags: Word; var dispParams: TDispParams; var Result: PVariant;
        excepInfo: PExcepInfo; argErr: PInteger): HRESULT; override;
    // *** Changing GetAutoObject from a virtual function
    // to a static function
    // function GetAutoObject: TAutoObject; virtual; stdcall;
    function GetAutoObject: TAutoObject; stdcall;
end;
```

FIGURE 5: The modified declaration of `TAutoDispatch`.

```
// the Make Type Library (mktyplib)
// tool to produce the type library
// named Project1.tlb.
[ uuid(062C7183-7DF1-11CF-896C-
444553540000), version(1.0) ]
```

The `uuid` argument is the class ID of the Automation object's type library, used by the COM API functions `LoadRegTypeLib` and `QueryPathOfRegTypeLib` for manipulating type libraries registered in the system Registry.

```
library ProjX
{
    importlib("stdole32.tlb");
```

This line imports the standard type declarations for the `Mktyplib` compiler. Essentially, an ODL file uses a C++-style syntax, and needs to know about certain predefined types. This is the role of the `stdole32.tlb` file.

```
// Experimental dual interface
[ uuid(062C7182-7DF1-11CF-896C-
444553540000),
helpstring("Foo dual interface."),
oleautomation,
dual
]
```

This statement block sets up the declaration for the dual interface. The `uuid` argument uniquely identifies the interface, as is required for all custom interfaces in COM. That allows developers using the Automation object to request a particular dual interface rather than asking for a generic `IDispatch` interface. The `helpstring` argument adds a description to the type library. Finally, the key arguments are

the `oleautomation` and the dual parameters. The dual parameter identifies this interface as a dual interface.

```
interface IDualInterface : IDispatch
{
    HRESULT Foo([in] long l,
        [out, retval] long* iRet );
    HRESULT Bar([in] BSTR s );
};
```

This section declares the structure of the `IDualInterface` dual interface. The interface statement declares a new interface, `IDualInterface`, that is derived from an `IDispatch` interface. This means that the dual interface has the member functions of the `IDispatch` interface as its first seven member functions.

The lines in the statement block identify the custom functions implemented by this dual interface. All member functions in a dual interface must return an `HRESULT` parameter—a standard error result code defined in `ole2.pas`. So a function that returns any other value must pass its return value in one of the parameters in its argument list. The first function, `Foo`, illustrates this: It places its return value in the `iRet` argument.

Note that there are special directives enclosed in the square brackets. All interface member function parameters must be identified as either `in` or `out`. The `retval` directive identifies `iRet` as the return value of the function `Foo`.

The `Bar` function illustrates how you can pass strings to and from Automation objects. Note that all strings must be `BSTRs`, the native string type of Automation. A `BSTR` contains both the length of the string and a terminating



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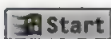
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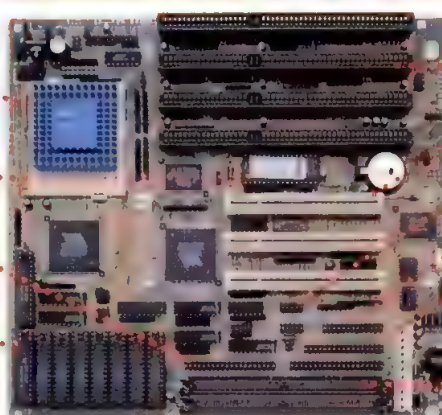
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NULL. In Win32, however, BSTRs are composed of 2-byte Unicode characters.

```
// Class information for
// TDualInterface
[ uuid(062C7181-7DF1-11CF-896C-
44453540000) ]
coclass TDualInterface
{
[default] interface IDualInterface;
};
```

Finally, this section identifies the COM object that is our Automation object. The uuid must match the uuid generated by Delphi's Automation Expert for our Automation object.

If you use the Project1.odl file as a template for your own ODL files, you won't have any problems building your own type library. To run the Mktyplib utility, just type

```
MKTYPLIB Project1.odl
```

and Mktyplib will compile Project1.odl into Project1.tlb. If you're using MIDL 3.0, which ships with the Windows NT 4.0 Beta 1 SDK, you can modify your ODL file to support the IDL syntax or you can use MIDL 3.0 in Mktyplib-compatibility mode:

```
MIDL /mktyplib203 Project1.odl
```

IMPLEMENTING THE DUAL INTERFACE

Getting Delphi to support dual interfaces involves making a few modifications to the oleauto.pas unit in the VCL source code. We'll build a new unit called dualauto.pas, incorporating changes to oleauto.pas. The changes are fairly minor, and I will highlight the places where I have made them.

First, let's take a look at how oleauto.pas works, concentrating on how oleauto.pas implements the IDispatch interface. For now, we'll ignore how most of the late-binding facilities (GetIDsOfNames, for example) work.

All new Automation objects must be derived from TAutoObject, which implements all of the IDispatch member functions. But the vtable for TAutoObject does not map directly to any of the IDispatch member functions. In fact, none of the IDispatch member functions in TAutoObject are defined as virtual, as we can see from the declaration of TAutoObject in Figure 3.

So how does Delphi create a vtable for the IDispatch member functions? TAutoObject contains a nested class, called TAutoDispatch, that does very little: It just delegates its functionality back to TAutoObject. It refers to its parent TAutoObject object through a private data member, initialized when TAutoDispatch is constructed, that stores a reference to the parent. We can see from the override keywords in Figure 4 that all of the member func-

tions of TAutoDispatch are virtual.

This method of implementing the IDispatch interface is quite advantageous for us. Because our dual interface inherits from a standard IDispatch interface, most of the work is accomplished by deriving a new class from TAutoDispatch. Still, some changes are necessary.

The majority of the changes to oleauto.pas fall into one of two categories: changes that promote certain data members and methods from private to protected status, so that we can access them from derived classes, and changes that facilitate type-safe IDispatch interfaces. For example, I added a new field to the AutoClass-Info structure so that we can declare a unique interface identifier for our dual interface.

Let's first modify the TAutoDispatch class. Because GetAutoObject is declared as a virtual function, it will always appear as the first member function of any dual interface object that we declare. This is not the desired behavior, and since there doesn't seem to be any pressing need for GetAutoObject to be a virtual function, I've made it nonvirtual.

We also need to be able to access TAutoDispatch's FAutoObject data member from derived classes. Note that classes declared within the same unit have unrestricted access to all private data members and functions of any other class within that unit. But we want to use dualauto.pas as a generic library function,

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and we want to be able to derive a new class from `TAutoDispatch`, but in a different unit. The only way to do this is to declare the `FAutoObject` data member as protected rather than as private. You can see the new declaration for `TAutoDispatch` in Figure 5.

Similarly, we need to be able to access the member functions `FRefCount` and `FAutoDispatch` in `TAutoObject`. So I've also changed the declarations of these data members to protected from private.

To create type-safe dual interfaces, I've added a new data member, `FIID`, to track our dual interface's interface identifier. The following classes, structures, and functions are also modified for the same purpose:

```
TAutoClassInfo
TRegistryClass
TClassFactory
DllGetClassObject
```

Space prohibits going into the details of how each of these classes and structures were modified. If you're interested, take a look at the source code for `dualauto.pas`. The changes are minor—just enough to allow us to set the `FIID` parameter in a derived class of `TAutoObject`.

The only *important* change to the code was in the `QueryInterface` function of `TAutoObject`. Here, we look for specific requests from the

Automation controller for our dual interface. This is necessary because Automation controllers that understand how to call dual interfaces always prebind to the Automation object's type library. That way, the Automation controller knows the IID for our dual interface and can call `QueryInterface` for our specific interface. It was for the same purpose that, as part of the registration process for our Automation object, we had to add code to identify the dual interface. We only need to change one line of code in `TAutoObject.QueryInterface`, from

```
if IsEqualIID(iid, IID_IUnknown) or
IsEqualIID(iid, IID_IDispatch) or
IsEqualIID(iid, IID_IAutoDispatch)
then

to

// MODIFIED - look for our custom IID
// upon QueryInterface
if IsEqualIID(iid, IID_IUnknown) or
IsEqualIID(iid, IID_IDispatch) or
IsEqualIID(iid, IID_IAutoDispatch) or
IsEqualIID(iid, FIID) then
```

Our modifications to `oleauto.pas` are now complete. All we need to do from now on is to include `dualauto.pas`, instead of `oleauto.pas`, in all of our Automation objects. Keep

in mind that `dualauto.pas` is `oleauto.pas`, with the addition of extended support for dual interfaces.

CREATING THE DUAL-INTERFACE OBJECT

Now that we have extended `oleauto.pas` to support dual interfaces, using it is extremely simple. First, create a new Automation unit using Delphi's Automation Expert, with a class called `TDualInterface`. You'll wind up with a declaration for `AutoClassInfo` as follows:

```
const
  AutoClassInfo: TAutoClassInfo = (
    AutoClass: TDualInterface;
    ProgID: 'Project1.DualInterface';
    ClassID: '{062C7181-7DF1-11CF-
      896C-444553540000}';
    IID: '{062C7182-7DF1-11CF-896C-
      444553540000}'; //<- Add this line!
    Description: '';
    Instancing: acMultiInstance);
```

The structure as supplied by Delphi will not include the IID field, and the value of the `ClassID` field will be different from what's shown here, as this number is generated by the `CoCreateGuid` member function in the COM libraries. You must insert the IID field and its GUID value. To keep things simple, I use the `ClassID`, with the last digit in the first

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group incremented by 1, as the GUID.

Let's add a couple of functions to our TDualInterface class. We'll call them Foo and Bar. Foo takes an integer, adds 1 to it, and returns the result, and Bar displays a string in a message box. Here are their declarations:

```
type
  TDualInterface = class(TAutoObject)
  private
    { Private declarations }
  public
    // Override TAutoObject constructor
    constructor Create; override;
  automated
    { Automated declarations }
    function Foo(i: Integer): Integer;
    procedure Bar(s: String);
  end;
```

You must also derive a new class, TDualDispatch, from TAutoDispatch. TDualDispatch will contain stub functions for your real Automation functions. The stub functions delegate the real functionality to your implementation in TDualInterface. Here's the definition for our sample TDualDispatch class:

```
// Dual interface dispatch driver!
TDualDispatch = class(TAutoDispatch)
public
  // declare new virtual functions
  // ** Must be stdcall!!
  function Foo(i: Integer; var iRet:
    Integer): HRESULT; virtual; stdcall;
  function Bar(s: PWideChar): HRESULT;
    virtual; stdcall;
end;
```

Note that we must declare all of the functions to be called with the stdcall calling convention.

The Bar function simply displays a string sent from the Automation controller. This string is passed as a pointer to a WideChar (Unicode) string. All strings passed to the COM API functions must be Unicode strings. Let's take a look at the Foo and Bar functions:

```
function TDualDispatch.Foo(i:
  Integer; var iRet: Integer): HRESULT;
begin
  // Delegate call to the real Foo
  iRet :=
    TDualInterface(FAutoObject).Foo(i);
  Result := S_OK;
end;
```

Foo delegates the call to the TDualInterface function Foo. As we noted before, all return values for TDualInterface's functions must be placed in the return parameter iRet of the corresponding TDualDispatch function. The value returned by the Foo function is a success or failure code that's reported to the Automation controller.

The function Bar is a bit more complex, because of the need to convert a Unicode string into a Delphi string. Delphi does the conversion automatically when the Automation controller calls the Automation object using the IDispatch interface's Invoke function. But since the Automation controller calls a dual interface function directly, we need to do the conversion in our stub function:

```
function TDualDispatch.Bar(s:
  PWideChar) : HRESULT;
begin
  // Delegate the call to the real Bar
  TDualInterface(FAutoObject)
    .Bar(WideCharToString(s));
  Result := S_OK;
end; {TDualDispatch.Bar}
```

Keep in mind that our dual-interface object can still be called via the IDispatch interface. Therefore, controllers that don't know how to call an Automation object via a dual interface can still call functions in the Automation object. They simply don't get the performance benefits of the dual interface.

RUNNING A DUAL-INTERFACE OBJECT

Now that we have finished building and compiling our dual-interface object, there's only one thing left to do: We must register the Automation object. Since our object is housed in a DLL, we must use the Regsvr32.exe utility to register our server. All Regsvr32 does is call the DllRegisterServer function exported by our DLL. The RegisterServer function in oleauto.pas does the rest.

Currently, the only way to build an Automation controller that supports dual interfaces is by using Visual Basic 4.0. We will build two versions of our Automation controller code. One version of the code will exploit the early-binding feature of Visual Basic 4.0. The other version will call the Automation object only using late binding through the IDispatch interface.

The early-binding version of the code is built by adding our Project1.tlb type library to Visual Basic's References list. You can do that by clicking on the Browse button in the References dialog and selecting your type library.

The References list allows Visual Basic code to refer to an external object as if it were one of its own. The early-binding version of the code is

```
Dim s As ProjX.TDualInterface
```

We are declaring a new object variable, s, to refer to our Automation object. Our type library is ProjX, and the Automation object we want to refer to is TDualInterface. Visual Basic 4.0 will load the type library at compile-time and use it to enforce strong-typing rules. In other words, all functions you refer to must be listed in the type library, and Visual Basic will ensure that you cannot pass illegal parameters to them.

```
Dim i As Long
Dim timeStart
Set s = New ProjX.TDualInterface
'Call Functions in Delphi automation dll
s.Bar ("Hello World")
timeStart = Timer
i = 0
While i < 100000
  i = i + 1
  i = s.Foo(i)
Wend
MsgBox("Time:" & Timer - timeStart)
Set s = Nothing
```

The rest of the code exercises the functions in our Automation object. We call the Bar function, which displays a string, and we call the Foo member function in a tight loop to test the overhead of a dual-interface call.

Our late-binding code is identical to the early-binding code above. The only difference is the way in which the object variable is declared. Rather than referring to a type library in Visual Basic's References list, we declare a generic Object variable and call Visual Basic's CreateObject member function:

```
Dim s As Object
Set s =
  CreateObject("Project1.DualInterface")
```

PERFORMANCE

How fast is our dual interface? Unfortunately, since we're using Visual Basic, it is difficult to measure actual speed differences. That's because the loop overhead in Visual Basic when calling a dual-interface function is very large, compared with the time required to call the function in our Automation object. Therefore, I can only present a lower limit of approximately 12 times as fast. The real number is probably somewhere in the neighborhood of 500 times as fast. But since Visual Basic is the *only* dual-interface Automation controller right now, you can expect to see about a twelfold improvement.

Also keep in mind that the dramatic increase in performance occurs only with in-process Automation objects (those packaged inside DLLs). If you need to make a cross-process or remote Automation call where the Automation marshaller must get involved, you will get a much smaller performance boost—somewhere in the neighborhood of 20 percent. The overhead that Windows enforces for a memory-context switch, in the case of a cross-process call, and the overhead required for a Remote Procedure Call will also limit performance. But as with any technique with the potential to dramatically improve performance, you'd ignore dual-interface objects at your own peril. □

John Lam is president of Naleco Research (www.naleco.com), a developer of utilities for Windows 95.

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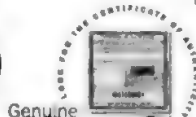
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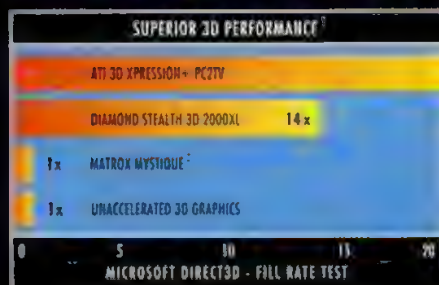
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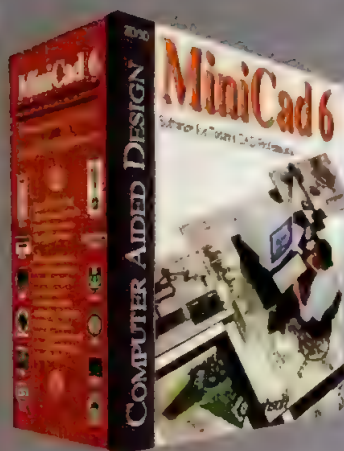
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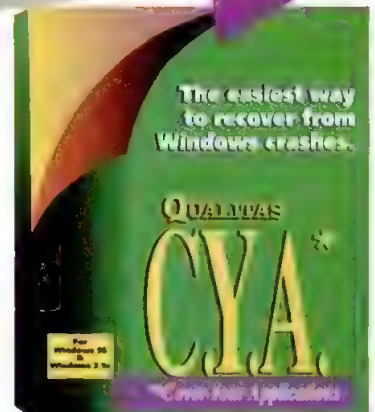
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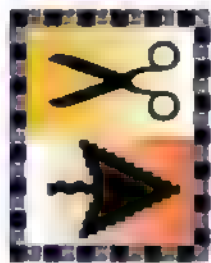
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By Neil J. Rubenking

Attach Notes to Files

Explorer Notes adds a notes column to Explorer's file details.

Explorer Notes, this issue's utility, enhances Windows 95 Explorer by letting you associate a note of up to 255 characters with any file or folder. When Explorer is displaying files in detail view, Explorer Notes adds a fifth column for note display. The column also appears in the detail view of Windows 95 standard file dialogs (see Figure 1). Right-click on a single file to add, edit, or remove that file's note, or select a group of files and then right-click to append a keyword or phrase to each selected file's note. Explorer Notes was inspired by the DOS-based *PC Magazine* utility DIRNOTES, written in 1987 by Michael J. Mefford.

Filenames in Windows 95 can be long and informative, but most users don't clutter each filename with a full description of the file's contents. With Explorer Notes, you can add a descriptive note to a file independently of the long filename. You can add keyword-style notes to a group of files at once. And you can search for files whose notes contain a particular word or phrase.

Explorer Notes is designed specifically to integrate with Windows 95 Explorer, and it exploits very particular details of Explorer's internal workings. It will not work with Windows NT 4.0, and it may require an update to function with the next version of Windows 95.

You can obtain Explorer Notes by downloading it from PC Magazine Online or by mail. (Refer to the sidebar "Guide to Our Utilities" for details.) The source code for Explorer Notes, which was written with Delphi 2.0, Borland's 32-bit visual programming tool, is also provided, for those interested.

INSTALLING EXPLORER NOTES

To install Explorer Notes, copy the files *Expnotes.exe*, *Expnotes.hlp*, *Expnotes.cnt*, and *En_dll.dll* into the directory of your choice. All four files must reside in the same directory. To set up Explorer Notes to run every time you start Windows 95, add it to the StartUp folder, as follows:

1. Launch Explorer and navigate to the directory that contains *Expnotes.exe*.
2. Click on *Expnotes.exe* and drag it onto the Start button.
3. Right-click on the Start button and select Explore.

4. Note that a shortcut for *Expnotes.exe* is visible in the right-hand pane of Explorer.
5. In the left-hand pane, open the Programs folder below the Start menu.
6. Drag the *Expnotes.exe* shortcut to the StartUp folder, below the Programs folder. Now Explorer Notes will start every time you start Windows 95.

Explorer Notes doesn't have an exit or quit option. Because it integrates so tightly with the essential Windows 95 Explorer, it cannot be removed with perfect safety. To quit Explorer Notes, you must remove it from the StartUp menu (if present) and then restart Windows 95.

IN THIS ISSUE

Explorer Notes

Explorer Notes enhances Windows 95 Explorer by letting you associate a note of up to 255 characters with any file or folder. The Explorer Notes Control window provides a Find dialog that lets you find files by searching through your notes.



USING EXPLORER NOTES

Explorer Notes should always be loaded before Explorer. If Explorer is already displaying files in detail view when Explorer Notes loads, the Notes column heading will appear, but the notes won't, until you open a different folder. Thus, the best way to load Explorer Notes is through the StartUp menu, as explained above.

You'll also need to set two of Explorer's view options to the values Explorer Notes requires. Specifically, on the View tab of Explorer's View Options dialog, you must check the check box titled "Display the full MS-DOS path in the title bar," and you must clear the check box titled "Hide MS-DOS file extensions for file types that are registered." Explorer Notes examines these settings when it starts; if they're not correct, it walks you through the process of setting them correctly.

You can adjust the size of the Explorer window or change the widths of the other columns to get the best view of the Notes column. In the system file dialogs, you won't see the Notes column at all until you shrink one of the other columns. Beware of imitations: Some file dialogs, such as those in Word 7.0, are not standard file dialogs. Explorer Notes cannot display notes in nonstandard dialogs.

Explorer Notes adds an Add/Edit Note menu item to the context menu that appears when you right-click on a single file or folder. (Remember that you must right-click on the filename, not on the note.) When you select this menu item, a note-editing dialog displays the file's existing note, if there is one. You can add, edit, or delete a note using this dialog. There is a limit of 255 characters, and any tabs, carriage returns, or other control characters will be replaced by spaces. The change takes effect as soon as you click on the OK button, but it may not show up in Explorer for a few seconds.

If you select multiple items and then right-click on one of them, the added menu item will be Append Note. Selecting it will bring up the same note-editing dialog, but without the display of any existing notes. The text you enter will be added to each selected item's note. If an item has no note, the new text will become its note; if it has one, the appended text will be preceded by a semicolon and a space and the expanded note will be truncated at 255 characters, if necessary. Figure 2 shows both versions of the note-editing dialog.

THE CONTROL WINDOW

When Explorer Notes is active, it displays a tiny icon in the Taskbar's notification area. You can click on this icon to bring up the Explorer Notes Control window, which will always appear in the corner of the screen nearest the icon. Figure 3 shows the control window, along with the Explorer Notes Taskbar icon, between the volume control and the clock.

Once you've assigned notes to your most important files, you may want to search for files whose notes contain a particular word or phrase. To this end, the Find button on the Control window brings up a standard Win-

dows Find dialog. Enter the text to search for, check or clear the case-matching check box, and click on Find Next. If a match is found, Explorer Notes will activate Explorer and select the corresponding file or folder. The Find dialog is configured to float on top of other windows, so you can easily locate it to find more matching files. When you're finished searching, click on Cancel to put the Find dialog away.

When you click on the control window's Find button, Explorer Notes starts searching from the beginning of the stored list of notes. Each time you click on Find Next in the Find dialog, Explorer Notes starts the search just after the previous match. If there are no matches at all, Explorer Notes will display the message "No notes contain <text>." After the last of one or more matches, it will display the message "No more notes contain <text>."

Occasionally, the Find feature may inform you that it has found a note, but that the corresponding file doesn't exist. Explorer Notes stores its data in the Registry key HKEY_CURRENT_USER\Software\PC Magazine\Explorer Notes\1.0\Notes. It uses a sparse copy of the system's directory tree structure that includes only the branches that contain files that have notes. When you add a new note, Explorer Notes creates any new branches it needs. When you delete a note, Explorer Notes deletes any branches that are no longer necessary.

If a file that has a note is deleted, renamed, or moved to a new location, its note, no longer associated with an existing file, will be "orphaned." Similarly, using DOS commands to delete, rename, or move a directory containing a file with a note will cause the note to be orphaned. But if you use Explorer to move, rename, or delete folders, the association between files and their notes will not be broken. A Windows 95 program can get notification from the system when these specific actions occur, and Explorer Notes takes advantage of that limited feature by modifying its internal storage tree to match the change in the directory tree.

You can minimize the occurrence of orphaned notes by doing all your file manipulation through Explorer, and taking extra care when moving or renaming files that have notes. To move or rename a file without losing its note:

1. Right-click on the file and select Add/Edit Note.
2. Highlight the note and press Ctrl-C, then click on Cancel.
3. Move or rename the file.
4. Right-click on the moved or renamed file and select Add/Edit Note.

5. Press Ctrl-V to paste the note, then click OK.

No matter how careful you are, there will probably be some orphaned notes in Explorer Notes's storage tree. To clean up the storage tree, click on the Prune button in the control window. Explorer Notes will check every note in its storage area to be sure it corresponds to an existing file or directory. When it finds a note whose file doesn't exist, it logs the filename and note and then deletes the note from storage, along with any branches that are no longer needed. The log file Expnotes.log is created in the same directory as Expnotes.exe. After each prune-

functions. A COM interface's functions correspond directly to virtual methods in a Delphi (or C++) object. In fact, you can create a COM interface by declaring a Delphi class with the right set of virtual methods.

Every COM object must support the IUnknown interface and its functions, AddRef, Release, and QueryInterface. AddRef and Release manage the object's lifetime by keeping a reference count, freeing the object when the count reaches 0. The QueryInterface function provides access to all other interfaces supported by the object. (For more details on COM objects and Delphi, see this issue's Power Programming column, "Dual Interfaces Using Delphi.")

The interfaces used by Windows 95 shell extensions are descendants of IUnknown. They support the three IUnknown functions, along with additional interface-specific functions. A Delphi class implementing just one such interface can be defined as a simple descendant of the IUnknown class. The problem comes when an object has to support multiple interfaces that are not descendants of one another. For example, a context-menu shell extension must support both the IContextMenu interface and the IShellExtInit interface. Many examples of shell extension programming are available, but nearly all are written in C++ and use multiple inheritance to solve the problem. Delphi programmers must take a different approach.

The key to writing a shell extension (or any other COM object) in Delphi is understanding that the main object serves as a container for the interfaces: The object does not provide each set of interface functions directly. The main object is a direct descendant of IUnknown, and it contains a private data field defining an instance of each interface it needs to supply. Its constructor initializes these satellite interface objects, and its destructor destroys them. The object responds to QueryInterface by returning a pointer to the satellite object corresponding to the requested interface. Figure 4 shows the type declarations for the shell extension in En_dll.dll and its satellite interfaces.

ISatelliteUnknown is a descendant of the IUnknown interface, defined in Delphi's OLE2 unit. IUnknown's constructor receives a pointer to its container and implements each of the three IUnknown methods by calling the corresponding method of the container. The IMyShellExtInit, IMyContextMenu, and IMyCopyHook objects descend from ISatelliteUnknown, and each defines virtual methods corresponding to the functions added by that interface. For example, the IMyContextMenu interface defines QueryContextMenu, which

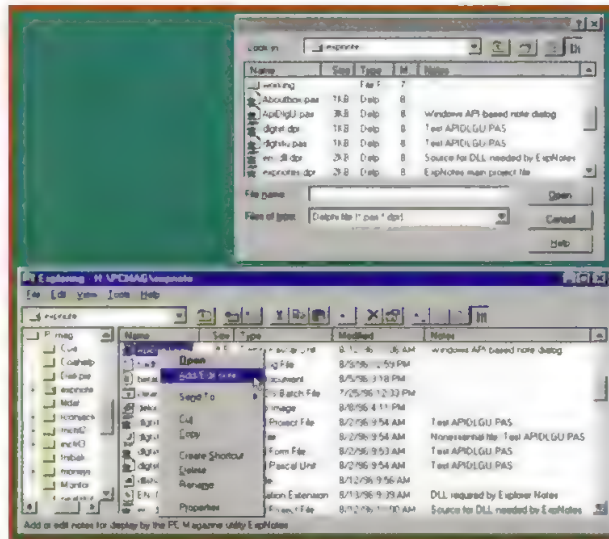


FIGURE 1: Explorer Notes adds a notes column to the file detail view, both in Explorer itself and in Windows 95 standard file dialogs.

ing, you should check this log file, as you may want to retrieve and reuse some of the notes.

PROGRAMMING EXPLORER NOTES

The Expnotes.exe program file contains the user interface for Explorer Notes, but all of the interesting programming takes place in the Explorer Notes DLL, which implements two Windows 95 shell extensions: a context-menu handler and a copy-hook handler. The DLL subclasses windows belonging to other processes (a difficult task, as each process runs in its own memory context). And the DLL accepts user input without using any of the Delphi component classes, a technique that saves memory.

EXTENDING THE WIN 95 SHELL

As you've doubtless heard many times by now, programs can integrate new behavior seamlessly into the Windows 95 shell by using Component Object Model (COM) objects called *shell extensions*. COM is the object specification underlying OLE and ActiveX. COM objects expose *interfaces* to the outside world, and each interface handles certain specific



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adds menu items; `InvokeCommand`, which is called when the user clicks one of the menu items; and `GetCommandString`, which provides a description of each command. The essential `stdcall` keyword after each new virtual method declaration forces the compiler to use the Win32 standard calling convention.

Figure 4 also shows the implementation code for the main shell extension object. Its constructor creates the three satellite interfaces, as noted above. It also initializes a `TStringList` object that is used internally to hold the list of selected files. This list is provided to the `IMyShellExtInit` interface and used by the `IMyContextMenu` interface. The constructor initializes the object's reference count to 0 and increments the reference count of the DLL itself (more on the DLL reference count later). In its destructor, the shell extension object frees its satellite interface objects and decrements the DLL's reference count.

The standard names for `QueryInterface`'s parameters are `rIID` and `ppv`; I replaced these abstruse names with `WantIID` and `ReturnedObject`. `QueryInterface` compares the requested interface ID passed in `WantIID` with several system-defined interface IDs and returns a pointer to the appropriate satellite object, if a match is found. These interface IDs are 128-bit GUIDs (Globally Unique Identifiers) defined by the system. The shell extension has its own GUID, generated by the Windows API function `CoCreateGUID`. For each shell extension you write, you'll need to generate at least one new GUID (in case you were wondering, the GUID for the Explorer Notes shell extension is {6A5EF9E0-DFCE-11CF-9A34-44A553540000}).

The main body of the DLL is contained in the file `En_dll.dpr`. This file implements and exports two functions essential to every shell

extension: `DllGetClassObject` and `DllCanUnloadNow`. The other examples in this article have been given intelligible names.

A shell extension DLL must implement the `DllGetClassObject` function, but that function will be called only if the shell extension is registered with the system. The other two functions exported by `En_dll.dll` handle registering and un-registering the shell extension. `ExpNote_Activate` registers the shell extension as a context-menu handler for all files by adding a key to the Registry's list of context-menu handlers, at `HKEY_CLASSES_ROOT\*\ShellEx\ContextMenuHandlers`, using the shell extension's GUID as the key's value. In a similar fashion, `ExpNote_Activate` registers the shell extension as a context-menu handler for the directory type, and as a copy-hook handler for both types.

The next step is to register the GUID itself by creating a key under `HKEY_CLASSES_ROOT\CLSID`, using the GUID as the key name. Below this key, `ExpNote_Activate` creates a key named `InprocServer32` whose default value is the full pathname of the DLL. This key must also have a named value with the name "ThreadingModel" and data "Apartment." The process of registering a shell extension may seem complex, but once you've written the code, you can use it again and again with only minor changes.

The `ExpNote_DeActivate` function simply removes all of the Registry keys added by `ExpNote_Activate`. It is called by Explorer Notes when your Windows session ends; that way, there's no de-installation required if you choose not to run Explorer Notes during your next Windows session.

PUTTING DLLS ON A DIET

One virtue of Delphi is that its programs can be completely self-contained, requiring only a single .EXE file. That's possible because the Delphi compiler links in all the code required to manage the components used in the program and discards any code that is completely unused. A do-nothing Delphi 2 program will

be about 150KB in size, because of the initial overhead of including the component system. But as you add components and code, the .EXE size grows very slowly, since much of the needed support code is already present.

In early versions, the Explorer Notes DLL used a Delphi form to let the user enter note text. Rather than incur the 150KB overhead in

the DLL as well as in the .EXE file, I decided to implement the note-editing dialog without relying on Delphi's components. The Delphi source code that displays this resource-based dialog is available online.

The resource compiler supplied with Delphi, `Brc.exe`, compiles the resource script `Apidlg`

.rc into a .RES file. Each of the dialog-box controls has a corresponding identifier, defined in an include file that is shared by the .RC file and the .PAS file. The `EdNote` function starts by initializing three variables to define the dialog caption, label text, and

edit-box text, then invokes the dialog using the API function `DialogBox`. If the returned value is 0 or greater, `EdNote` cleans up the returned string and passes it back to the calling function.

Every dialog box needs a dialog-box procedure to handle its messages. Internally, the dialog-box procedure returns `True` to indicate that it handled a message or `False` to request default handling. This dialog procedure responds to `WM_INITDIALOG` by copying the caption, label, and edit strings into their correct locations and setting a 255-character limit on the edit box. It responds to a click on the OK button by copying the edit box's text back into the passed structure and returning its length. If Cancel is selected, the dialog procedure returns -1.

If you began your programming career with Delphi, you may never have experienced this kind of Windows programming. It certainly seems terribly nonvisual. But using this bare-bones technique reduced the DLL's size from 212KB to 62KB.

THE FIFTH COLUMN

To add a column to a Windows 95 listview control, you send the `LVM_INSERTCOLUMN` message to the control, passing the column number and a pointer to a structure that defines the column. However, when 32-bit processes are involved, the pointer is valid only in the memory context of the process that created it. If the listview is owned by another process, it won't be able to access the passed structure. In addition, the text for a particular row and column within the listview need not be stored with the listview itself. Commonly, the listview's parent window supplies the text in response to a `WM_NOTIFY` message, with the notification code set to `LVN_GETDISPINFO`. This, too, can be accomplished only in the memory context of the process that owns the listview.

Explorer Notes solves these memory-

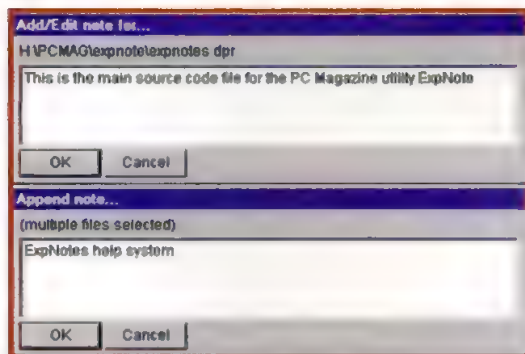


FIGURE 2: This simple dialog serves either to edit the note for an individual file or to append a word or phrase to the notes for selected files.

extension: `DllGetClassObject` and `DllCanUnloadNow`. The system calls `DllGetClassObject` to get an instance of the shell extension object implemented in this DLL. It calls `DllCanUnloadNow` to determine whether it's okay to unload the DLL: If the DLL's reference count is 0 and no locks are active, the DLL can be unloaded. The only real differ-

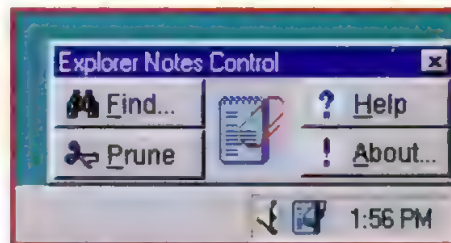
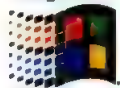


FIGURE 3: Clicking the paper-clipped notebook icon in the Taskbar brings up the Explorer Notes Control window.



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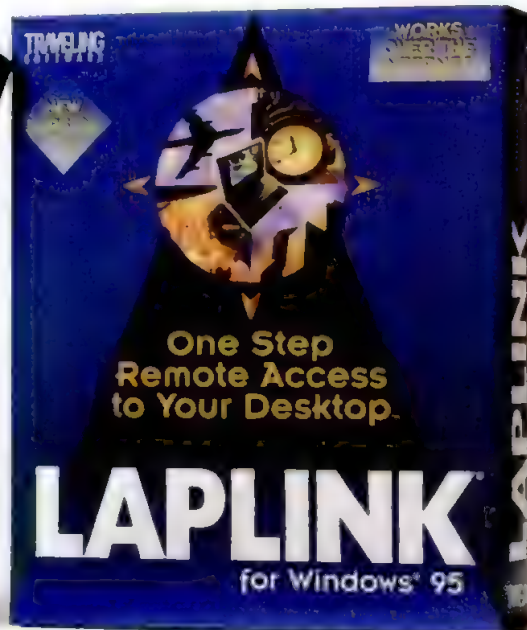
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```

VAR DllRefCount, LockCount : Integer;

type
  IMyShellExtension = class;

  ISatelliteUnknown = class(IUnknown)
  // Meant to be contained by an IMyShellExtension.
  // Reflects the three IUnknown functions to its
  // container.
  private
    fContainer : IMyShellExtension;
  public
    constructor Create(vContainer: IMyShellExtension);
    function QueryInterface(const WantIID: TIID;
      var ReturnedObject): HRESULT; override;
    function AddRef: Longint; override;
    function Release: Longint; override;
  end;

  IMyShellExtInit = class(ISatelliteUnknown)
  public
    function Initialize(pidlFolder:PitemIDList; lpdobj:
      IDataObject;
      hKeyProgID:HKEY):HRESULT; virtual; stdcall;
  end;

  IMyCopyHook = class(ISatelliteUnknown)
  public
    function CopyCallback(Wnd:HWND;wFunc:UINT;
      wFlags:UINT;
      pszSrcFile:LPSTR; dwSrcAttribs:DWORD;
      pszDestFile:LPSTR;
      dwDestAttribs:DWORD):UINT; virtual; stdcall;
  end;

  IMyContextMenu = class(ISatelliteUnknown)
  public
    function QueryContextMenu(Menu:HMENU; indexMenu:UINT;
      idCmdFirst:UINT;idCmdLast:UINT;
      uFlags:UINT):HRESULT;
      virtual; stdcall;
    function InvokeCommand(lpici: PCMINVOKECOMMANDINFO):
      HRESULT;
      virtual; stdcall;
    function GetCommandString(idCmd:UINT; uType:UINT; var
      pwReserved:
      UINT; pszName:LPSTR; cchMax:UINT):HRESULT; virtual;
      stdcall;
  end;

  IMyShellExtension = class(IUnknown)
  private
    FRefCount : Integer;
    FShellExtInit : IMyShellExtInit; // Satellite
    FCopyHook : IMyCopyHook; // Satellite
    FContextMenu : IMyContextMenu; // Satellite
    FNumFiles : Integer;
    FInitFiles : TStringList;
  public
    constructor Create;
    destructor Destroy; override;

    {IUnknown functions}
    function QueryInterface(const WantIID: TIID;
      var ReturnedObject): HRESULT; override;
    function AddRef: Longint; override;
    function Release: Longint; override;
  end;
  ...
  implementation
  constructor IMyShellExtension.Create;
  begin
    Inherited Create;
    FRefCount := 0;
    FInitFiles := TStringList.Create;
    FShellExtInit := IMyShellExtInit.Create(Self);
    FCopyHook := IMyCopyHook.Create(Self);
    FContextMenu := IMyContextMenu.Create(Self);
    Inc(DllRefCount);
  end;

  destructor IMyShellExtension.Destroy;
  begin
    Dec(DllRefCount);
    FShellExtInit.Free;
    FCopyHook.Free;
    FContextMenu.Free;
    FInitFiles.Free;
    Inherited Destroy;
  end;

  function IMyShellExtension.QueryInterface(const WantIID:
    TIID;
    var ReturnedObject): HRESULT;
  VAR P : IUnknown;
  begin
    IF IsEqualIID(WantIID, IID_IUnknown) THEN
      P := FContextMenu
    ELSE IF IsEqualIID(WantIID, IID_IContextMenu) THEN
      P := FContextMenu
    ELSE IF IsEqualIID(WantIID, IID_IShellExtInit) THEN
      P := FShellExtInit
    ELSE IF IsEqualIID(WantIID, IID_IShellCopyHook) THEN
      P := FCopyHook
    ELSE P := nil;
    Pointer(ReturnedObject) := P;
    IF P = NIL THEN Result := E_NOINTERFACE
    ELSE
      begin
        P.AddRef;
        Result := S_OK;
      end;
    end;
  end;

  function IMyShellExtension.AddRef: Longint;
  begin
    Inc(FRefCount);
    Result := FRefCount;
  end;

  function IMyShellExtension.Release: Longint;
  begin
    Dec(FRefCount);
    Result := FRefCount;
    IF FRefCount = 0 THEN Free;
  end;

```

FIGURE 4: A Delphi COM object supports multiple interfaces by maintaining them internally as separate objects.



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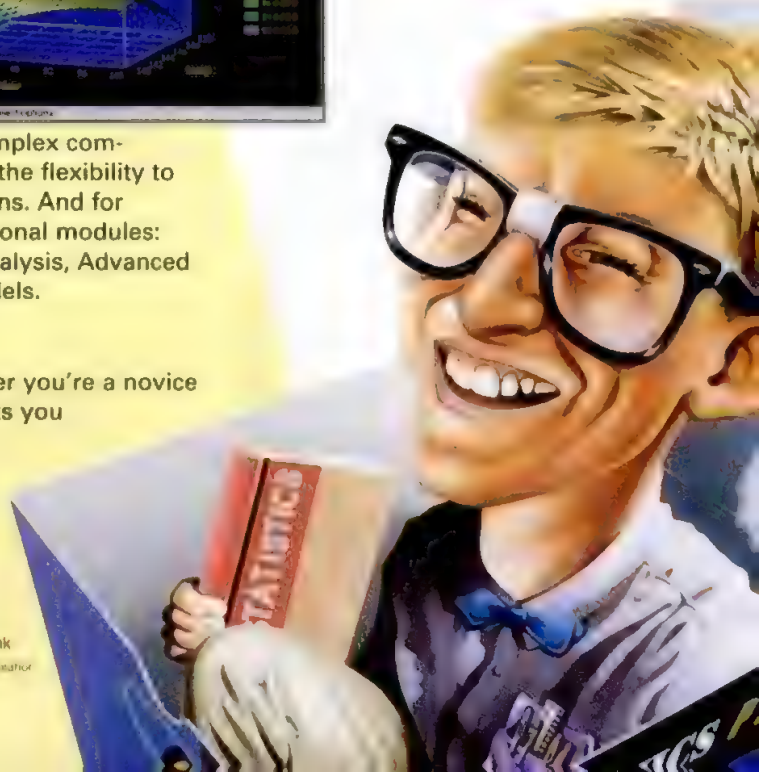
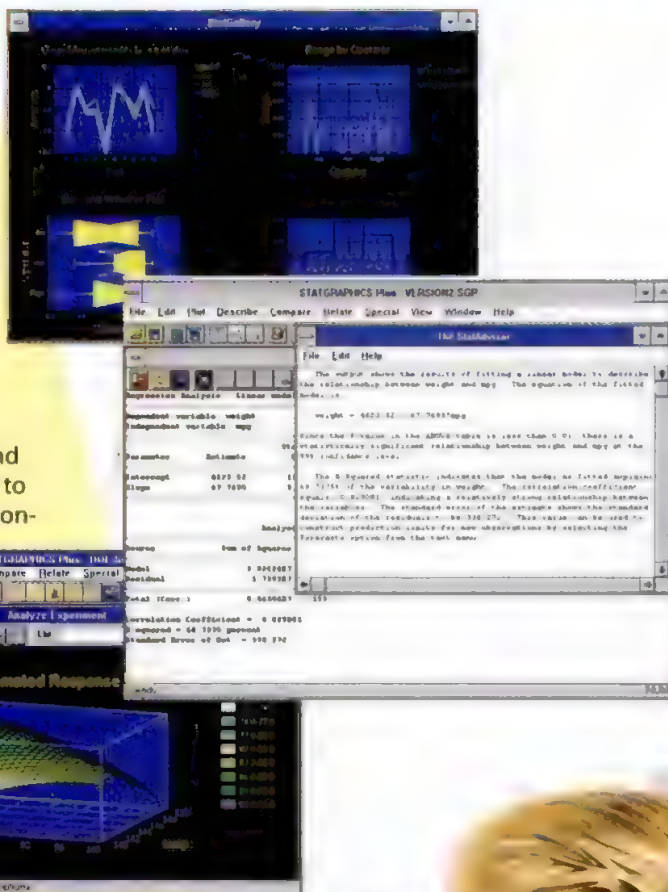
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context problems by implementing a WH_CBT (computer-based training) Windows hook in its DLL. A CBT hook procedure gets called each time certain important events occur in a window's life, among them its creation, its destruction, and its receiving of focus. At the time the hook procedure is called, it is running in the memory context of the process that owns the window. Thus Explorer Notes can successfully add a notes column to Explorer's listview and can subclass the listview's parent to respond to LVN_GETDISPINFO notifications by supplying the appropriate note text.

Alas, the memory-context woes aren't over. A given hook type can be processed by multiple hook procedures, so a well-behaved hook procedure passes each notification it receives to the next hook in the chain. The SetWindowsHookEx function installs a Windows hook and returns the old hook value. Within the hook procedure, the CallNextHookEx function passes along the notification to the old hook. However, the SetWindowsHookEx function is called in the memory context of Explorer Notes, and the CallNextHookEx function is called in the memory context of the active process. Global variables in a DLL are not shared between different instances of the DLL (at least not without a special linker directive that's not supported in Delphi). Thus, a different storage technique is required.

THE TOP 10 UTILITIES

- 1 **QUOD** A new computer game
- 2 **INCTR3** Monitors Win 95 installations
- 3 **CHECKE** Windows checkers game
- 4 **FDDLLS** Finds dead DLLs
- 5 **WINBAR** Runs programs automatically
- 6 **SPAD** Enhanced Windows notepad
- 7 **PICALB** Organizes image files
- 8 **1MBF** Protects low memory
- 9 **MULTIL** Adds launch choices in Win 95
- 10 **INCTR2** Monitors program installation

The Win32 concept of memory-mapped files provides the solution. When the DLL is activated, it creates a memory-mapped file just big enough to hold the old, 4-byte hook value, and passes a handle to this memory-mapped file back to Explorer Notes. When the DLL needs to reference the old hook value, it checks to see whether the value is 0, meaning the

active instance of the DLL doesn't have access yet. If so, it opens the memory-mapped file, reads the value, and closes the file. When Explorer Notes terminates, the original handle to the memory-mapped file is closed, and the file disappears. The code that installs and uninstalls the CBT hook, along with the hook procedure itself, is available online.

There's no documentation for the internals of Explorer, no list of class names used, and no description of the process of initializing a listview. I developed the CBT hook procedure through observation and experiment. Explorer's listview control has a class name of SysListView32; its parent window's class name is SHELLDLL_DefView and its parent's parent is Explorer. When the HCBT_CREATEWND event occurs, the hook procedure checks to see whether the window being created fits this profile. If so, it stores the listview's window handle and subclasses the parent. There's no point in adding the Notes column at this time, because the newly created listview has not been initialized.

When an HCBT_SETFOCUS event comes in for an Explorer listview, the hook procedure adds the Notes column to the listview and adds a subitem for the new column to each existing item. It sets the subitem's text to the value LPSTR_TEXTCALLBACK, which causes the listview to send an LVN_DISPINFO noti-

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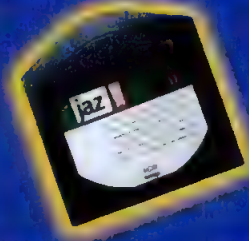
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cation to its parent whenever it needs to display that subitem's text.

A new listview is created every time the user opens a new folder in Explorer. But if the user switches to a new folder using the directory tree view in Explorer's left-hand panel, the newly created listview does not get the focus, the HCBT_SETFOCUS notification is not triggered, and a notes column is not added. What's needed here is another event occurring soon after the listview's creation but not before its initialization. The solution lies in the fact that a new SHELLDLL_DefView parent is created for the new listview before the old listview and parent are destroyed. When the HCBT_DESTROYWND event occurs for a SHELLDLL_DefView, the hook procedure adds the Notes column to the just-created listview.

As noted earlier, the text for a notes col-

umn's subitems is not stored with the listview. Rather, the text for each item's notes column is set to the value LPSTR_TEXTCALLBACK. When the listview needs to display an item, it requests the text from its parent.

The subclass window procedure tests whether the message is WM_NOTIFY with a notification code of LVN_GETDISPINFO and a subitem number of 4. If so, it extracts the path from Explorer's caption and gets the complete filename, including extension, from the text of the first column. This is why Explorer's view options must be set to display the full path in the caption and to show extensions for all files. If a note exists for the file, the window procedure copies it into the item structure that was passed with the notification message.

When you click on one of the column headings in Explorer, the file list is sorted based on that column. Click again on the same heading

and the sort order is reversed. Despite much experimenting, I've found no way to sort on a notes column. By default, clicking on a notes-column header sorts the list by name. To avoid confusion, the window procedure suppresses clicks on notes-column headers. Specifically, when the window procedure receives a WM_NOTIFY message with a notification code of LVN_COLUMNCLICK and a subitem number of 4, it sounds the default system error beep.

From the outside, Explorer Notes looks simple. It inserts one tiny context-menu item, adds one simple-looking new column in Explorer, and, when requested, displays a minuscule control window. It's amazing how much programming effort had to be expended behind the scenes to produce this apparent simplicity! □

Neil J. Rubenking is the technical editor of PC Magazine.

GUIDE TO OUR UTILITIES

ABOUT EXPLORER NOTES...

PURPOSE Explorer Notes enhances Windows 95 Explorer by letting you associate a note of up to 255 characters with any file or folder. Explorer Notes adds a fifth column to Explorer's detail view for note display; a notes column also appears in the detail view of Windows 95 standard file dialogs. The Explorer Notes control window provides a Find dialog that lets you find files by searching through your notes.

USAGE To install Explorer Notes, copy the files Exnotes.exe, Exnotes.hlp, Exnotes.cnt, and EN_DLL.DLL into the directory of your choice. All four files must reside in the same directory. To set up Explorer Notes so that it runs every time you start Windows 95, add it to the StartUp folder. Explorer Notes should always be loaded before Explorer.

Explorer Notes adds an Add/Edit Note menu item to the context menu that appears when you right-click on a single file or folder icon. When you select this menu item, a note-editing dialog displays the file's note, if there is one. If you right-click on one of a group of selected items, the added menu item's text will be Append Note. Selecting this menu item will bring up the same note-editing dialog but without the display of existing notes. The text you enter will be added to the note for each of the selected items. If an item has no note, the new text will become its note.

When Explorer Notes is active, it displays a tiny icon in the Taskbar's notification area. You can click on this icon to bring up the Explorer Notes Control window, which contains four buttons: Find, Prune, Help, and About.

To search for a particular note, use the Find button. Occasionally, the Find feature may inform you that it has found a note, but that the corresponding file doesn't exist. You can minimize the occurrence of these orphaned notes by doing all of your file manipulation through Explorer. No matter how careful you are, however, there will probably be some orphaned notes in Explorer Notes's storage tree. To clean up the storage tree, press the Prune button in the Control window.

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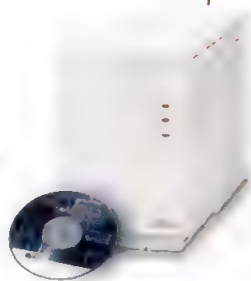
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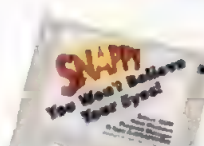
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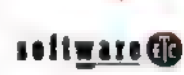
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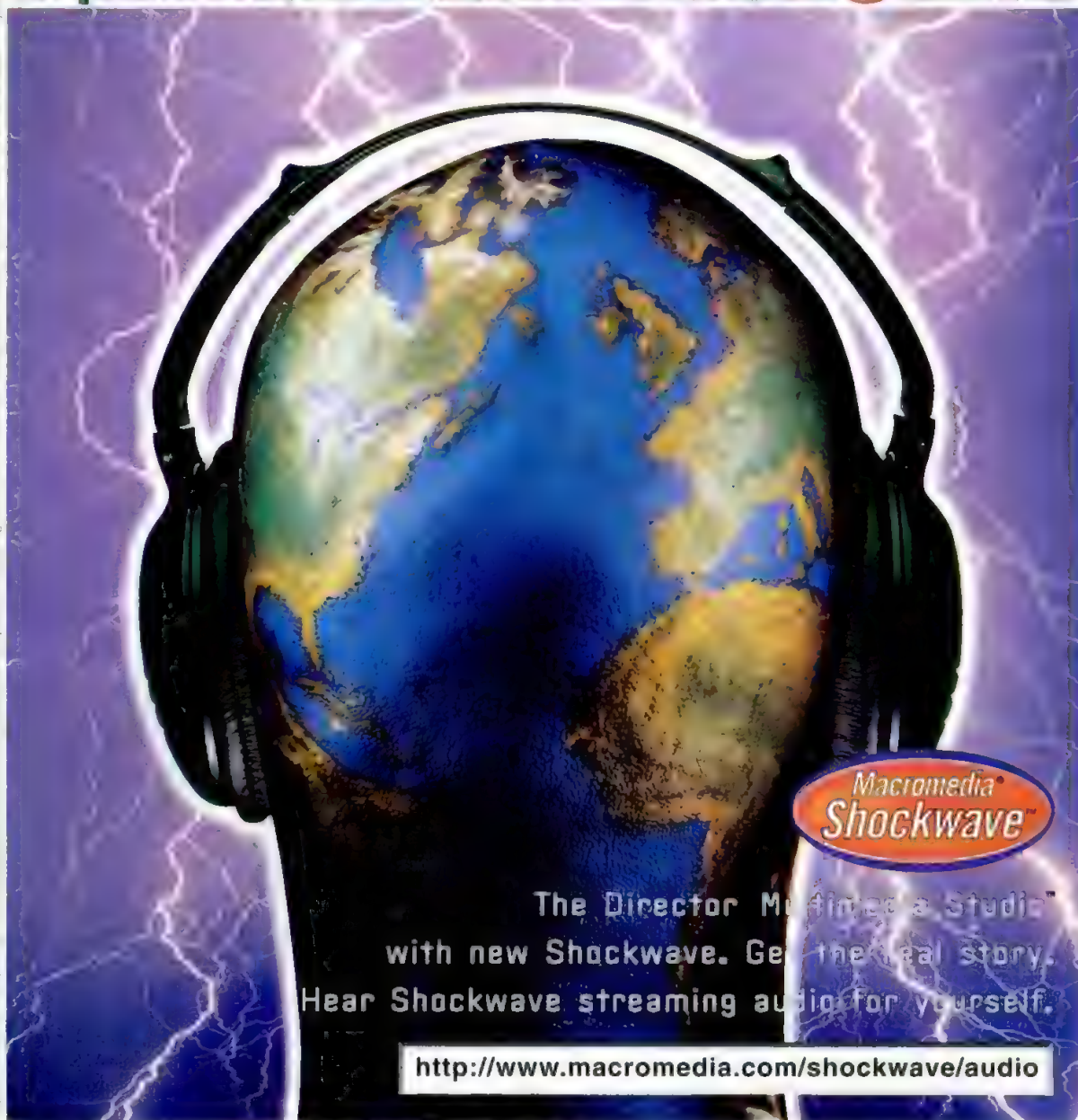
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Dot Pitch (mm)	.25*	.25*	.25*	.28	.26
H. Freq. Range (kHz)	24-82	24-82	30-68	30-68	30-65
Max. Resolution	1600 x 1280	1600 x 1280	1280 x 1024	1280 x 1024	1280 x 1024
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By Brian Proffitt

Merlin's New Robes

A tour of OS/2 Warp 4.0's improved interface.

The most visible change in OS/2 Warp 4.0, previously code-named Merlin, is in its user interface. IBM has done a number of things to make Warp easier to use—and easier on the eyes. Immediately after installing Warp 4.0, you'll notice that IBM has changed the appearance of the desktop, for example. More 3-D icons adorn a rather stylish rendering of the OS/2 logo over a textured background, making the desktop far more attractive than the flat, dull green monochrome in Version 3.0.

IBM has included several new bitmaps and wallpaper patterns with which you can customize your background in case you don't want your desktop to continue looking like a commercial. Just move the pointer to an empty portion of the desktop and click with the right mouse button. From the pop-up menu (notice the more attractive system fonts), click on Properties.

Another major change is that objects no longer have Settings Notebooks; they have Properties Notebooks instead. In the following sections, we'll look at these Properties Notebooks, the new System Setup folder capabilities, the new Internet desktop object types, the new WarpCenter—a turbocharged LaunchPad—and at WarpGuide, which helps you use and understand the new features of Version 4.0. In a future column, we'll explore one of the most intriguing new features of this Warp upgrade—the addition of speech recognition to the user interface.

WARPGUIDE LEADS THE WAY

When a Properties Notebook opens, you'll see that more than just the name has changed; the new Notebooks look dramatically different. Before we look at the desktop wallpaper options, let's take a moment to explore a couple of other new things in front of us. If this is the first time you've tried to modify your system's settings, a dialog pops up asking you to check in with WarpGuide, a set of wizards designed to help you through common system-setup operations. The level of help you get can change, based on the level of help you need. So the first thing WarpGuide asks about is your familiarity with computers and with OS/2. WarpGuide monitors your usage of the system, gradually adjusting the amount of

help it offers to fit your level of expertise.

As you can see in Figure 1, WarpGuide directs your attention to a particular part of the dialog by lightly graying out the rest of the window. As you move through the fields in the window, the grayed-out portions and the help text change according to your current location. WarpGuide is available for only a few selected system functions, but developers may start taking advantage of this capability to provide customized help for their own applications. If you don't like WarpGuide, you can click on the WarpGuide properties button to turn it off.

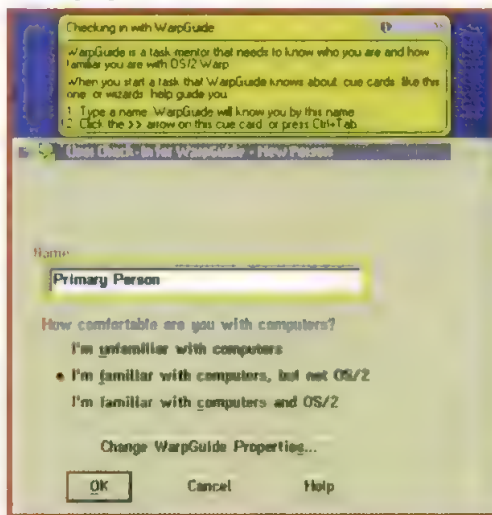


FIGURE 1: WarpGuide adjusts the amount of help it provides to your level of experience.

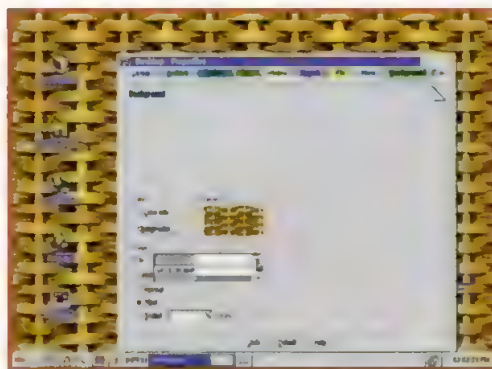


FIGURE 2: You can choose from dozens of wallpapers and bitmaps.

Notebooks are different in Version 4.0, too (see Figure 2). You'll notice, for example, a new button in the upper-right-hand corner of a Notebook. The box with a diagonal line through it—next to the minimize and maximize buttons—is a close button. A single click here will close the current window. The tabs, which are now colored, rest along the top of the window and change in size based on the amount of text they contain. You can move through the pages of this new Notebook more easily. The blue arrow at the end of the tabs allows you to shift the whole set of tabs over in order to see more page headings. Clicking on any tab moves immediately to that page in the Notebook.

Some sections, of course, contain more than one page. You can flip through a Notebook one page at a time by clicking on the plus and minus signs in the upper-right corner of the page. A newly introduced technique lets you move the pointer to the upper portion of the page and click with the right mouse button to bring up a window showing a list of all the tabs. Tabs representing more than one page have cascading menus, allowing you to move directly to the desired page.

Getting back to the task at hand, click on the Background tab to change to the view shown in Figure 2. If you click on the drop-down arrow next to the filename, you will find around 50 different patterns with which you can customize your desktop background.

THE SYSTEM SETUP FOLDER

That's just the beginning of the new customization possibilities. Open the OS/2 System folder and then the System Setup folder within it to see the window shown in Figure 3. This looks much the same as it did in Version 3.0, but new possibilities lurk within these objects. For example, if you open the Sound Notebook, you'll find a new tab labeled Scheme. Several sound schemes are included with Warp 4.0 to let you tailor the effects you hear as you operate the system.

You'll encounter new possibilities for the mouse pointer as well. If you open

the Mouse Notebook and click on the Pointers tab you can access the Load Set button, which lets you select from more than 20 pointer sets of various colors and shapes. (But OS/2 still lacks animation like that of the rotating hourglass in Windows NT.)

More new options are hidden in the System Notebook. Open it and click on the User Interface tab and you'll see that there's now a choice for Full Window Dragging. This simply means that when you are moving or resizing a window, the whole window—rather than just

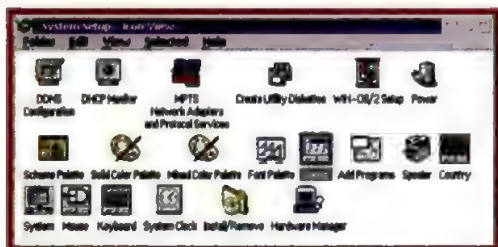


FIGURE 3: The System Setup folder provides broad customization power.

a set of lines indicating the window's border—is shifted dynamically. Full Window Dragging is not a default setting, because it appears somewhat jerky on lower-end systems. But most people will find the system easier to use by selecting this option.

The Alt-Tab Switching Window option on this page selects another new interface feature. Users of Microsoft Windows are accustomed to using Alt-Tab to pop up a small box that pages through the icons representing open windows, thus facilitating movement between applications. Now Warp has this option too—well, almost. Only Presentation Manager programs are shown; command prompt sessions don't appear in the list.

The VIO Mouse Actions check box allows you to simplify copy-and-paste options in command prompt sessions by activating direct mouse operation in those windows. This works for both OS/2 and DOS windowed command prompts.

And without going into great depth (for more details, see "Merlin Brings Magic to OS/2," September 24, 1996), let's just say that the Asynchronous Focus Change option makes Warp 4.0 more stable. A poorly written program is less likely to be able to keep you from switching to other programs if this option is activated.

NEW DESKTOP OBJECT TYPES

But it isn't just the appearance and behavior of the desktop that's changed in Warp 4.0. You also have the option of creating new types of desktop objects. Acknowledging the popularity of the Internet, Warp now allows you to create objects on the desktop designed to make Internet access as easy as possible. The Templates folder (now hidden within the OS/2 System folder) holds something new: a folder

containing templates for the Internet.

To create an Internet object, simply drag a template onto the desktop. Warp prompts you for the information needed to complete the object. For example, drag a URL object onto the desktop and Warp prompts for the Uniform Resource Locator address. In the example shown in Figure 4, we've created an object pointing to *PC Magazine's* Web site, at www.pcmag.com. Double-clicking on this object loads the WebExplorer browser automatically and points it to that site. You don't have to use a template, though: When looking at a favorite page in WebExplorer, you can drag it out of the browser and drop it onto the desktop to create a URL object.

The Properties Notebook for a URL object allows a lot of customization, too. For example, you can specify whether to load graphics from that page or to speed things up by using text only. You can define the server configuration, specifying news, proxy, and socks servers. You aren't restricted to WebExplorer, either—you can select the browser of your choice.

You can also drag off a template for a favorite FTP site that indicates the site's address and preferred directories. Then you can treat the FTP object just like a local drive, opening it to display its contents and dropping files onto it to initiate a file copy. Likewise, Java applets can be run directly from the desktop by dragging off a Java template.

WARPCENTER PROVIDES CENTRALIZED ACCESS

IBM tops off all of these enhancements with the WarpCenter, a cross between the LaunchPad in Warp 3.0 and the SmartCenter in Lotus SmartSuite. The WarpCenter provides easy access to the most common desktop activities while taking up a minimum of screen real estate. In fact, you can configure it (much as you can Windows 95's Taskbar) so that it isn't even displayed unless the user moves the pointer to the extreme top or bottom of the screen.

Clicking on the Warp logo rolls out a dynamic menu of all desktop objects (see Figure 5). As you add objects to your desktop, this menu will change automatically. Using WarpCenter, you can access your desktop objects without having to move or minimize the window—even if that window is maximized.

Since one of the objects on the desktop is the OS/2 System folder, which contains the Drives folder, you can get to any file in your system through the cascading menus in the WarpCenter.

The next button in the WarpCenter rolls out a menu of all active sessions in the system, including OS/2 and DOS command prompts. Through this menu you can jump quickly to

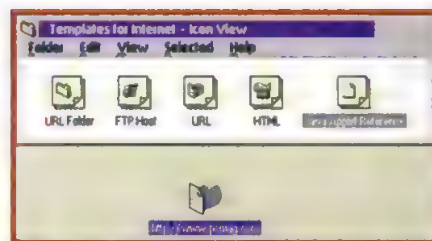


FIGURE 4: Warp 4.0 allows you to create Internet objects on the desktop.

the desired program. The lock button is a handy way to enter your system into a secured state, so that no one can use it until the password is entered. The flashlight button activates the Seek and Scan Programs utility, which helps you locate objects in your system. The final button on this section of the WarpCenter initiates system shutdown.

The next portion of the WarpCenter is a monitor area. This region can be configured to monitor system activity through a moving meter, similar to a pulse display. It can also indicate battery life on notebook systems or track the amount of free space on each of your system's disk drives. You toggle through these possible displays by clicking on the portion of the WarpCenter in which you're interested.

At the far right, the WarpCenter displays the system time. Clicking on that area switches the display to the current date. Clicking again switches to a stopwatch, which can be useful in monitoring such things as the amount of time spent online with a service that bills by the hour.

There's also a button that rolls out a menu showing the contents of the Assistance Center folder—a new object centralizing access to all of the online documentation for Warp, including documentation available on the Internet.

The empty area in the middle of the WarpCenter is a tray into which you can drop your favorite programs. With the icons of your most frequently used objects in the WarpCenter, it's easy to access them without having to



FIGURE 5: The WarpCenter provides quick access to desktop objects.

drill down through layers of folders. You can create several trays, too, and switch between them. Of course, if you really liked the old LaunchPad, you can still use it: It's available, as the Toolbar, in the OS/2 System folder. □

Brian Proffitt is a senior contributing editor of OS/2 Magazine and the author of OS/2 Warp Survival Kit, published by Addison-Wesley.

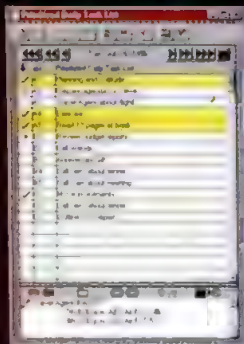
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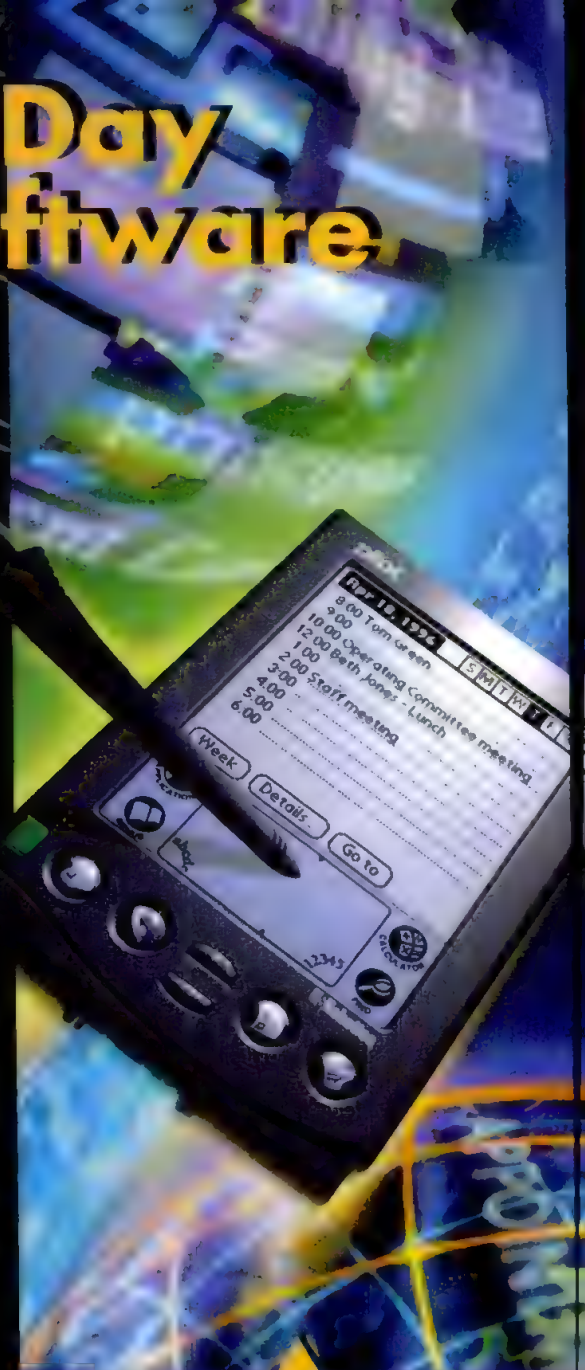
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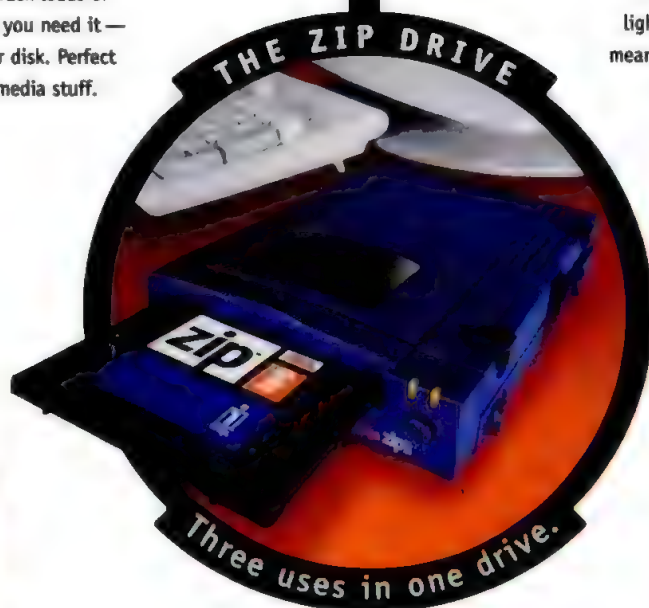
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CAD Suite Advantages

by Tom King.

Want to design your dream home, edit an existing house plan, or hash out a few creative changes on a CAD drawing? Can't afford the expensive software, or would like to start your own design/drafting business? Want dependable software and tools that really work together? Hint: think suite.

The advantages of suites hinges on the extra utilities or other features that make the main programs more productive. A single purchase provides this, plus the ability to correspond with a single software company if support is needed.

Caution! Creating with CAD will strip the very threads of your wallet ... unless you shop around.

The trend moving away from pricey, cumbersome programs, like AutoCAD, has apparently caught on. Take, for instance, a recent CAD suite from ViaGrafix: DesignCAD Office. This suite offers a full featured CAD system

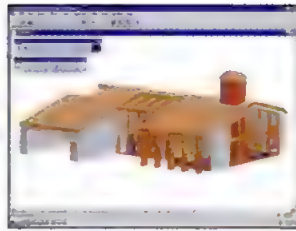
for under a thousand dollars. Say what???

Here's what they give you: DesignCAD 2D and DesignCAD 3D for Windows 95 software (two completely separate programs), cost estimation software, a scanning package, two video tutorials, and thousands of ready-to-use 2D and 3D professional symbols.

Anything helping to save time and boost productivity must be a good deal, right? Be careful, even though there are several combo-packages available, it might be advisable to get references or read the testimonials of actual users.

So, besides my own testimonial, try this one on for size. "I use DesignCAD for my drafting students because it's much easier to learn than AutoCAD," said Bill Stone, technology instructor at Junction City High, Junction City, KS.

The extra tools in DesignCAD



Office 95 include: Professional 2D and 3D symbol libraries (with thousands of pre-made symbols), a cost estimation program (Instant Estimator), a program used to convert

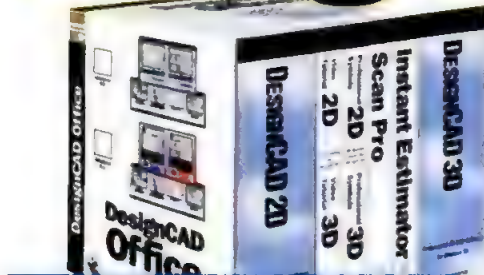
scanned files into CAD drawings (ScanPro), and two complete video tutorials for DesignCAD 2D and 3D. Yes, they even give you manuals and user guides and free technical support. Try it, you'll like it.

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Tom King hosts the syndicated "CompuTalk - The World's Source For Geek-Free Computer Radio" heard nationwide. Tom is also a computer reporter for CBS's KHOU-TV in Houston, Texas.

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*Computer Reseller News
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*Windows Magazine
Summer 1996*



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*New Media
November 1995*



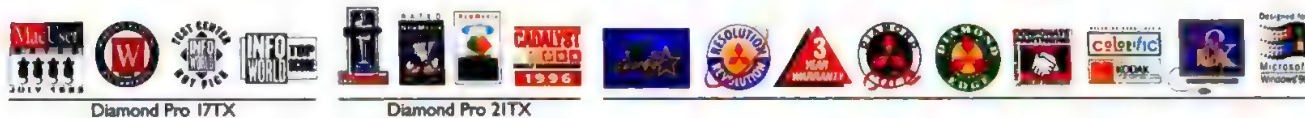
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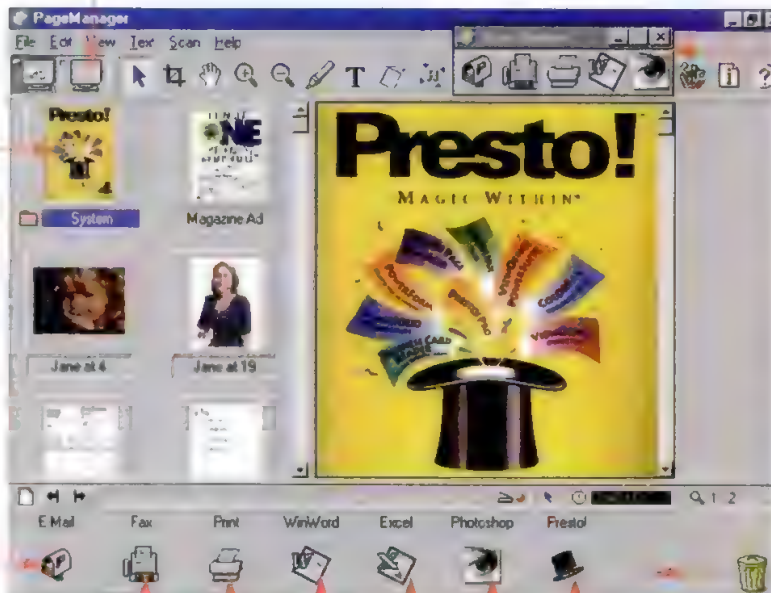
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New FreeHand Graphics Studio 7 with Shockwave.

the text around an arc. Then I used a cool 3D rotating tool, distorting it and giving it a new twist. The fonts I used were created in Fontographer 4.1. I tricked them up from the font Bureau. I saved time by using FreeHand's Union Patch/Intersect feature for the lines

that span out around the head. It was all done in a matter of days and parts. Then, I saved the big new image in Macromedia's

Image 3. To get green fingers on the hands, I trained a finger reader and extended it to look hands. But I also wanted this image to

be unusual, so I used the Saturation to achieve the green effect. Extreme. It came in handy to model the eyeballs and make them really pop. And voilà! My self portrait. Thanks for the great work. Look (and trust us, he's much better looking face to face.)

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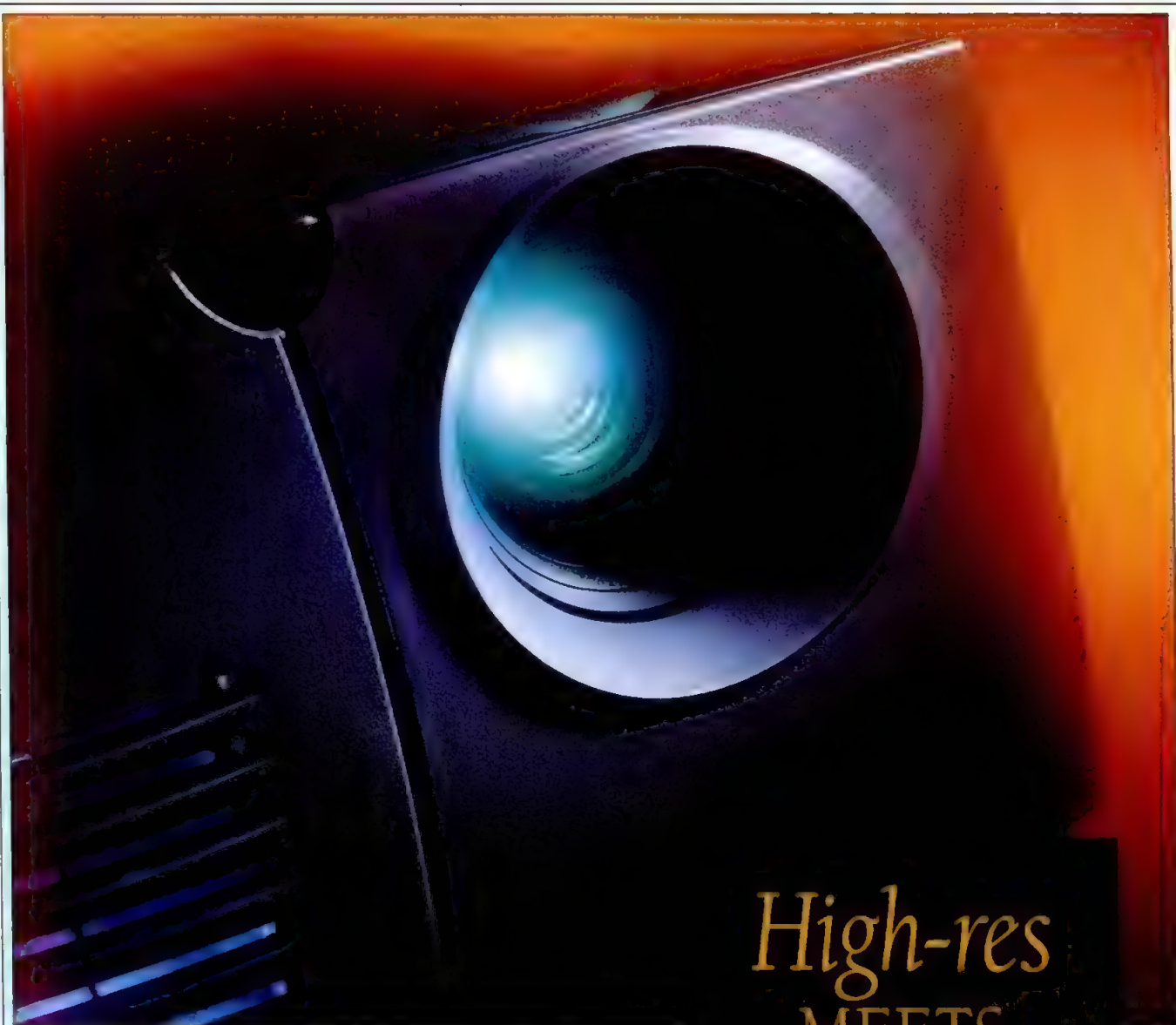
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IBM Thinkpad 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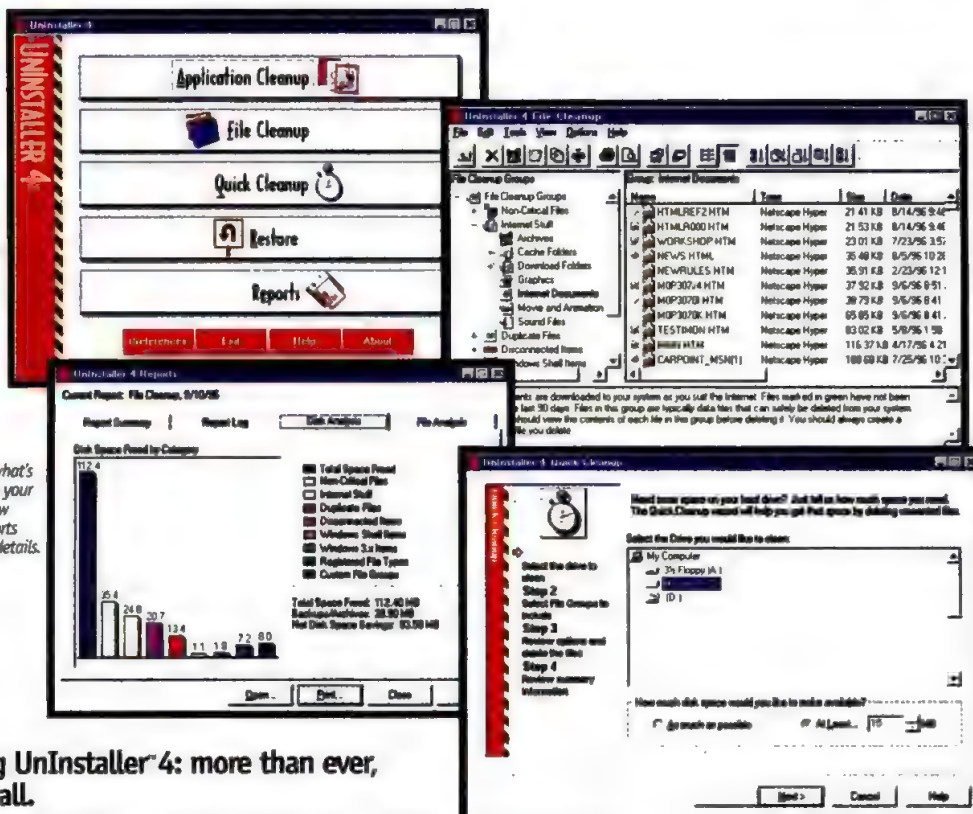
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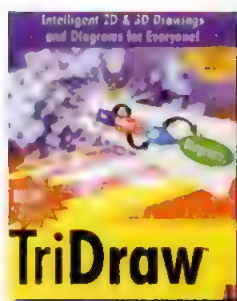
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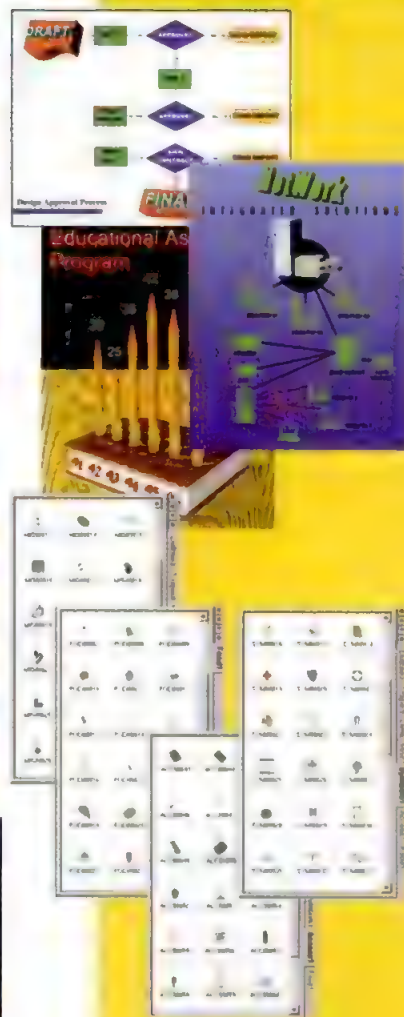
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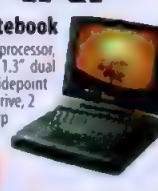


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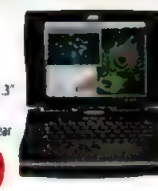


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User-to-User

By Neil J. Rubenking

Shift-Clicking in Windows 95

There's a convenient way to restart Windows 95 without going through an entire reboot. After choosing Shut Down from the Start menu and selecting Restart the Computer, hold the Shift key while clicking OK or pressing Enter. This restarts Windows 95, not the entire computer. Release the Shift key well after the click, or Windows will sometimes neglect your "wish with the fingertip."

Shift-clicking around in Windows 95 often reveals interesting features. For example, a Shift-right-click on a file in Explorer gives you the additional choice of opening that file with any of your registered programs. Shift-clicking on Explorer's Delete button or on the Delete command of the right-click menu bypasses the Recycle Bin and sends your file into Nirvana.

ARNO KLEBER
Bayreuth, Germany

PC MAGAZINE: As noted in an earlier User-to-User column, if you hold down the Shift key to restart Windows 95 (as opposed to rebooting the computer), you should keep holding it until the words "Windows is now restarting" appear on the screen. That way, you're sure to get the desired result.

When you Shift-right-click a file in Explorer, the menu items that show up include any that are defined for the particular file type, plus any that are defined for unknown file types. By default, the only menu item for unknown file types is Open With, as noted above. But if you've added other menu items for unknown file types, either by editing the Windows 95 Registry or by using the *PC Magazine* utility MenuEdit (described in the Utilities column of October 22, 1996), those items will also appear when you Shift-right-click.

Here's another Shift-click tip: If you open a series of folders to reach a particular file, you can wind up with quite a few folder windows on the desktop. You could close them one by one, of course, but if you hold down the Shift key while closing the deepest folder, all the rest will close as well. The Shift key can modify behavior in some Windows 95 applica-

tions, too. For example, in Microsoft Word 7.0, if you click the File menu, the third menu choice is Close, to close the current document. But if you Shift-click the File menu, the third menu choice is Close All, to close all open documents. Experiment! You're bound to find more examples.

A DOS Batch File Plays Tic-Tac-Toe

I have an example batch file that makes clever use of the CHOICE.COM utility (supplied with DOS 6.x or later) to implement a Tic-Tac-Toe game.

JOHN HILGART
Warrenville, Illinois

PC MAGAZINE: This laconic letter introduced a four-page, batch-file implementation of Tic-Tac-Toe. Intrigued, I spent some time tuning and trimming the file, reducing it to about half its initial size. Then I squandered the saved space by adding a second batch file that lets the computer play, too. That's right—the batch file plays Tic-Tac-Toe. Even if you don't care for games, you can apply the size-reduction techniques to your own batch files.

To start with, TIC-TAC.BAT (Figure 1) needs to initialize environment variables sq1 through sq9 (representing the contents of the nine squares) and a handful of others. Rather than devoting a line to each variable, it initializes them all in two FOR statements. Next, the batch file draws the game diagram and prompts the user to choose a square from 1 to 9 or to press Q for Quit.

Instead of using ten IF ERRORLEVEL statements to interpret the output of CHOICE, I again used the FOR command. A single line tests all ten possible values, setting the environment variable mv to each value for which the IF ERRORLEVEL test succeeds. This test is true if the actual ERRORLEVEL is greater than or equal to the specified value, so mv will end up containing the number of the actual ERRORLEVEL.

Next, the batch file must test whether the selected square is empty, and reject it if it's not. Getting the value of an environment variable whose name is calculated from another envi-

HIGHLIGHTS



HARDWARE How to verify whether you have the correct display driver loaded, and if you don't, how to get the right one installed. *Page 372*



OPERATING ENVIRONMENTS If you prefer the OS/2 Enhanced Editor over the System Editor, here are some steps you can follow to make EPM the default. *Page 378*



DATABASES A neat technique in Microsoft Access can slim down huge reports by letting you add an "all others" line. *Page 384*

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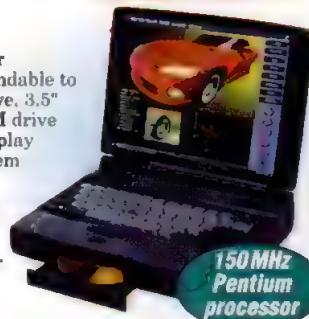
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- ✓ Integrated 4X CD-ROM drive
- ✓ External 3.5", 1.44MB floppy disk drive
- ✓ 10.4" dual-scan color display
- ✓ Pre-loaded Windows® 95
- ✓ 6.4 lbs.
- ✓ 1-year warranty with International Warranty Service*



SPECIAL PURCHASE!

IBM ThinkPad 365ED

- ✓ 100MHz 5x86C CPU
- ✓ 16MB RAM
- ✓ 810MB hard drive
- ✓ 4X CD-ROM drive
- ✓ 10.4" active-matrix display

\$2537.28

CDW 73202

ThinkPad 365ED with 4X CD-ROM

\$1969.00

CDW 68164

*Lotus SmartSuite 96 CD-ROM included. Diskette copies and hard copy documentation can be ordered for a fee through the IBM fulfillment center at 800-672-6165.

COMPAQ Armada 1120

A winning combination of features

- ◆ 100MHz Intel Pentium® processor
- ◆ 8MB RAM standard, expandable to 24MB
- ◆ 810MB hard disk drive
- ◆ 10.4" dual-scan (1120) or TFT active-matrix (1120T) color display
- ◆ 32-bit PCI local bus graphics
- ◆ 1-year worldwide limited warranty



1120 **\$1899.00** CDW 71110

1120T **\$2249.00** CDW 71111

NEC Versa 6000 Series

- ◆ 100MHz or 133MHz Intel Pentium® processor
- ◆ 16MB RAM standard, expandable to 48MB
- ◆ 1.08GB, 1.35GB or 1.44GB hard drive
- ◆ Includes 1.44MB floppy drive, 6X CD-ROM
- ◆ 11.3" or 12.1" TFT active-matrix color display
- ◆ Supports full-screen, full-motion MPEG video
- ◆ Cellular-ready 28.8K bps data fax/modem
- ◆ 6.9 lbs.
- ◆ 3-year limited warranty



6000H 100MHz, 1.08GB, 11.3" **\$3999.00** CDW 69805

6010H 133MHz, 1.08GB, 11.3" **\$4599.00** CDW 74821

6030H 133MHz, 1.35GB, 12.1" **\$4999.00** CDW 69807

6030X 133MHz, 1.44GB, 12.1" **\$5399.00** CDW 69808

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Aptiva C Series

Touch new worlds of power with IBM's Aptiva—the interactive PC for entertainment, education, communication and productivity

Along with being a powerful home computer, Aptiva is a communication center for business and leisure. All Aptiva models come with a host of advanced telephone answering capabilities that include a phone answering system, voice mail with remote access, full-duplex speakerphone and more. Aptiva's Total Image Video provides full screen, full motion MPEG playback for remarkably sharp video images and IBM's TheatreSound produces powerful "CD-quality" sound from two amplified stereo speakers. Aptiva also features one-button access to the Internet (requires additional fees)*.

■ Intel® Pentium® processors: 133MHz (C32, C33), 166MHz (C65), 200MHz (C73) ■ 256KB Level 2 cache (C65, C73 only) ■ 16MB RAM standard, expandable to 128MB ■ 1.2GB (C32), 1.6GB (C33), 2GB (C65) or 2.5GB (C73) hard drive ■ 1.44MB, 3.5" diskette drive ■ 6X (C32) or 8X CD-ROM drive ■ 2MB video memory standard ■ MPEG-1 video support ■ Stereo speakers and microphone ■ 28.8K bps data/fax/voice modem with speakerphone capabilities ■ Keyboard, 2-button mouse ■ Software: Microsoft Windows® 95, Plus!, Works, Encarta 96; Lotus SmartSuite 96, Quicken Multimedia SE and more! ■ 3-year limited warranty with 1 year on-site repair



Monitor sold separately

Aptiva C32

Aptiva C33

Aptiva C65

Aptiva C73

One-button access to the Internet!*

\$1799.00

CDW 74006

\$1999.00

CDW 73083

\$2449.00

CDW 73084

\$2899.00

CDW 73085

IBM Aptiva
Black 15" monitor

\$1199.00

CDW 74597



Monitor sold separately; models S66 and S78 pictured

IBM® Aptiva S Series

Not just a new look, a new level of functionality

The new IBM Aptiva S Series introduces the most advanced design in the home PC industry. The Aptiva S Series features a breakthrough, space-saving design with a unique media console that allows easy access to the CD-ROM drive and floppy drive. This allows the mini-tower CPU to be placed up to six feet away—even under your desk! IBM's leadership in integrating 3D graphics into home computing with Total Image 3D and Total Image Video provides the ultimate in realistic and exciting multimedia.

■ 166MHz (S64, S66) or 200MHz (S74, S78) Intel Pentium® processor
■ 256KB Level 2 cache ■ 16MB (S64, S66, S74) or 32MB (S78) EDO RAM standard, expandable to 128MB ■ 2.5GB (S64, S74) or 3.2GB (S66, S78) hard disk drive ■ "Pop-up" media console: 1.44MB, 3.5" diskette drive and 8X CD-ROM drive ■ 2MB video memory standard ■ Full-screen MPEG video support ■ Hardware assisted MPEG audio features
■ 28.8K bps DSVD data/fax/voice modem (free software upgradeability to 33.6K bps) ■ Voicemail, speakerphone and Caller ID capabilities
■ Keyboard and mouse (S64, S74) ■ Keyboard, cordless mouse and joystick (S66, S78) ■ Windows® 95 software ■ 3-year limited warranty with 1 year on-site repair

Aptiva S64

\$2649.00

CDW 74046

Aptiva S66

\$2799.00

CDW 74047

Aptiva S74

\$3049.00

CDW 74048

Aptiva S78

\$3399.00

CDW 74049

*Internet connectivity requires access services from an Internet service provider.

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AST.

AST 575

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- ▲ 630MB hard drive
- ▲ 32-bit PCI graphics ▲ 1MB video RAM ▲ Includes keyboard and mouse ▲ 1-year warranty

\$649.00

CDW 73926

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Savings!**

AST Bravo MS

Practical business computing solution with unparalleled value



Call for the new Pentium Pro processor models!



AST Bravo MS-T mini-tower computers

Model	CPU	RAM	Hard Drive	Price	CDW
5100	100MHz Pentium	16MB	1.2GB	\$1399.54	66976
5100	100MHz Pentium	16MB	2.1GB	\$1543.36	66977
5133	133MHz Pentium	16MB	1.2GB	\$1654.43	66978
5133	133MHz Pentium	16MB	2.1GB	\$1787.00	66980

AST Bravo MS desktop computers

Model	CPU	RAM	Hard Drive	CD-ROM	Price	CDW
5100	100MHz Pentium	16MB	1.2GB		\$1399.54	66976
5100	100MHz Pentium	16MB	2.1GB		\$1543.36	66977
5133	133MHz Pentium	16MB	1.2GB		\$1654.43	66978
5133	133MHz Pentium	16MB	2.1GB		\$1787.00	66980
5166	166MHz Pentium	16MB	2.1GB	6X	\$2052.28	66973

HP Vectra 500 Series

- 100MHz 120MHz or 133MHz Intel Pentium processors ■ 8MB RAM
- 850MB or 1.28GB hard drives ■ Selected models include 28.8K bps data/fax modems and CD-ROM drives ■ Windows 95
- Pre-installed software: ClarisWorks; Lotus Organizer; Adobe Acrobat and more!

As low as!

\$1199.00

CDW 72877

HP Vectra 500 Series PCs

The best PCs for small business

Hewlett Packard Vectra 500 Series PCs give you the power of Pentium® processors, the ease and versatility of Windows® 95, the convenience of a built-in 28.8K bps modem (515CCx, 515MCx), Microsoft productivity software and the unmatched reliability of Hewlett Packard products. No matter what your business, there's an HP Vectra 500 Series PC to meet your needs.

- Intel® Pentium® processors ■ RAM: 16MB standard, 128MB maximum ■ 1.28GB or 1.62GB EIDE hard drive ■ 6X CD-ROM drive
- S3 Trio64 graphics with 1MB DRAM standard, 2MB maximum
- 28.8K bps data/fax modem with answering machine and speakerphone (515CCx, 515MCx) ■ Pre-installed Windows® 95
- Pre-installed software: Microsoft® Office Professional with Bookshelf; Microsoft Publisher; Microsoft Plus! Companion for Windows 95; HP Discover; HP Help; HP Printer Ready; Microcom Carbon Copy Host for HP Remote Support; Cheyenne BitWare (515CCx, 515MCx)
- 1-year on-site warranty



HEWLETT
PACKARD

**Includes a
complete
suite of
Microsoft
software!**



Monitor sold separately

Hewlett Packard Vectra 500 Series PCs

Desktop	CPU	RAM	Hard Drive	CD-ROM	Price	CDW
510CD	120MHz Pentium	16MB	1.28GB	6X	\$1616.99	72888
Mini-tower	CPU	RAM	Hard Drive	CD-ROM	Price	CDW
515CCx	120MHz Pentium	16MB	1.28GB	6X	\$1819.45	72890
515CD	133MHz Pentium	16MB	1.62GB	6X	\$1828.75	72891
515MCx	133MHz Pentium	16MB	1.62GB	6X	\$2064.29	72892
515MCx	150MHz Pentium	16MB	1.62GB	6X	\$2171.11	72893
515MCx	166MHz Pentium	16MB	1.62GB	6X	\$2553.19	72894



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- ▲ Amazing sight, sound and motion with JBL Pro speakers and full-motion MPEG support
- ▲ Fast online access with a 33.6K bps data/fax modem

Monitor sold separately
Model 4112 shown

Desktop	CPU	RAM	Hard Drive	CD-ROM Drive	Price	CDW
4112	120MHz Pentium	16MB	1.6GB	6X	\$1499.00	73385
4122	150MHz Pentium	16MB	2.5GB	8X	\$1899.00	73486
Mini-tower	CPU	RAM	Hard Drive	CD-ROM Drive	Price	CDW
4704	133MHz Pentium	16MB	1.6GB	6X	\$1699.00	73389
6704	166MHz Pentium	24MB	2.5GB	8X	\$2399.00	73392



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BEST
BUY!**

Presario 7232 and 7240

- ▲ 120MHz (7232) or 133MHz (7240) Intel® Pentium® processor
- ▲ 8MB EDO RAM standard, 128MB maximum
- ▲ 1.6GB hard drive
- ▲ 4X (7232) or 6X (7240) CD-ROM drive
- ▲ 28.8K bps data/fax modem with full-duplex speakerphone
- ▲ Scanner keyboard with Windows 95 keys (7232 only)
- ▲ Software: Microsoft® Windows 95 and more! ▲ 3-year limited warranty

**SPECIAL
PURCHASE!**

Monitor and speakers sold separately



Presario 7232

\$1299.00

CDW 72133

Presario 7240

\$1399.00

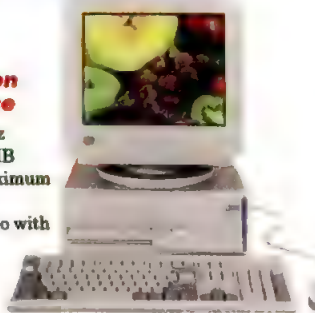
CDW 72137



PC 300 Series

**The perfect combination
of price and performance**

- ✓ 100MHz, 133MHz and 166MHz Intel Pentium® processors
- ✓ 16MB RAM standard, 192MB RAM maximum
- ✓ 1.2GB or 1.6GB hard drives
- ✓ S3 Trio64V+ PCI local bus video with 1MB EDO video memory
- ✓ 32-bit PCI local bus enhanced IDE controller
- ✓ Choice of SpaceSaver PC 330 (3x3) or Desktop PC 350 (5x5) models
- ✓ Pre-installed software: IBM PC DOS V7.0/Windows V3.1 or Windows® 95
- ✓ 3-year limited warranty



Monitor sold separately

IBM PC 330 Series						
CPU	RAM	Hard Drive	Expansion slots	Bay	Price	CDW
133MHz Pentium	16MB	1.2GB	3) PC/ISA	3	\$1739.91	69693
133MHz Pentium	16MB	1.6GB	3) PC/ISA	3	\$1808.89	69694
IBM PC 350 Series						
100MHz Pentium	16MB	1.2GB	3) PC/ISA, 2) ISA	5	\$1589.87	69695
133MHz Pentium	16MB	1.2GB	3) PC/ISA, 2) ISA	5	\$1775.70	69696
133MHz Pentium	16MB	1.6GB	3) PC/ISA, 2) ISA	5	\$1998.82	69699
166MHz Pentium	16MB	1.6GB	3) PC/ISA, 2) ISA	5	\$2146.32	69701

*Includes internal 6X CD-ROM drive

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PC 340 Series

**Exceptional value with
Pentium processor power**

IBM PC 340 systems provide an excellent combination of price and performance. Whether used as a single, stand-alone system or in a LAN environment, the PC 340 delivers the speed and solid functionality needed for off-the-shelf or customized applications.

- 100MHz or 133MHz Intel® Pentium® processor
- 16MB EDO RAM standard, expandable to 128MB
- Optional 256KB Level 2 cache
- 1.2GB EIDE hard disk drive
- Software: Windows® 95, NetFinity and Easy Tools network management tools
- Lotus SmartSuite license
- 3-year limited warranty



PC 340 100MHz Pentium	\$1389.16	CDW 71857
PC 340 133MHz Pentium	\$1618.87	CDW 71858
PC 340	\$1139.29	CDW 71856
■ 100MHz Pentium ■ 8MB RAM ■ 850MB hard drive		
■ DOS/Windows V3.1		

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THE ULTIMATE
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HL-720 laser printer

**Outstanding laser print quality
at the speed you need**

Optimized for Windows® 95 and 3.x, the Brother® HL-720 printer is designed with today's PC users in mind. When combining its quick, six page per minute engine, along with sharp, true 600 x 600 dpi resolution, the HL-720 is an excellent choice. The Brother HL-720 gives you outstanding laser print quality at the speed you need today—for your home or business, or both.

◆ Electrophotography print method ◆ Economy Print Mode ◆ 35 scalable TrueType™ fonts ◆ Enhanced Memory Management included to optimize available memory ◆ 200-sheet multi-purpose tray ◆ Manual Duplex Mode (2-in-1 page mode) saves paper consumption ◆ Straight Paper Path Technology reduces paper jams and curls ◆ Paper sizes: letter, legal, A4, B5, executive, envelopes, transparencies, laser label sheets ◆ Custom sizes: 2.75" x 5" to 8.5" x 14" ◆ Hi-speed, bi-directional centronics parallel port (IEEE 1284 compliant) ◆ Surf "n" Print software manages print jobs from the Internet of any Windows-based on-line service and turns files into convenient double-sided booklets ◆ 1-year limited warranty

NEW!



\$351.81

CDW 68497

HL-730 Windows & DOS printer **\$399.99** CDW 68498

Toner for 720 & 730 **\$26.34** CDW 68499

MFC-6550mc

Six-in-one message center

Printer ◆ True 600 x 600 dpi laser output ◆ 6 ppm print speed

◆ 756KB memory, expandable to 2.75MB

◆ 35 fonts for professional quality output ◆ Prints letter to legal size,

3" x 5", envelopes and heavier paper stocks

◆ Includes bi-directional parallel cable

◆ Exclusive straight

paper path technology minimizes jamming and

annoying paper curling problems

Message Center ◆ Built-in digital

answering machine ◆ Personal mailbox

capability ◆ Fax on demand

Copier ◆ 600 dpi class

output ◆ Multi-copying and sorting ◆ Copy enlargement

and reduction **Scanner** ◆ 600 x 600 dpi (interpolated)

◆ TWAIN compliant ◆ Includes Xerox Textbridge OCR

Fax ◆ 14.4K bps high-speed faxmodem

PC fax ◆ Send faxes directly from your PC



NEW!

MFC-4550

Five-in-one office solution

Printer* ◆ True 600 x 600 dpi laser output

◆ 6 ppm print speed ◆ 512KB memory,

expandable to 2.5MB ◆ 35 fonts

for professional quality output

◆ Prints letter to legal size,

3" x 5", envelopes and heavier

paper stocks ◆ Includes

bi-directional parallel cable

Copier ◆ Multi-copying

with sorting ◆ Copy

enlargement and reduction

Scanner* ◆ 400 x 400 dpi

(interpolated) ◆ Up to 8 ppm

scanning speed ◆ Xerox

Text Bridge OCR standard

◆ TWAIN compliant

Fax ◆ 14.4K bps high-speed

faxmodem

PC fax* ◆ Send faxes

directly from your PC

◆ Works in background to free

up your PC for other tasks



NEW!

\$799.99

CDW 71072

MFC-1950Plus **\$499.99** CDW 71064

◆ 14.4K bps modem ◆ 200 x 400 dpi laser output

◆ Built-in digital answering machine

Toner For 4550 and 6550mc **\$26.33** CDW 71982

*Requires Windows V3.1, V3.11, or Windows 95

\$999.99

CDW 71071



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Buy a BJC-4200 or BJC-4550 and get a BC-22 Photo Ink Kit **FREE!***

NEW!

BJC-4550 Color Bubble Jet™ printer

**Great big color for
Mac or PC**

For small or large tasks, the Canon® BJC-4550 is an outstanding value. Everything to meet the needs of a small business with big ideas has been considered, including the compact, space-saving size, and the convenience of dual interfaces for Macintosh® and PC.

■ 720 x 360 dpi resolution in color on plain paper, 720 x 360 dpi with smoothing in black and white ■ Maximum print speed: 1 ppm high quality color; 5 ppm high speed black and white ■ 300+ TrueType™ fonts on CD-ROM, 7 resident bitmap ■ 100 sheet built-in sheet feeder ■ Paper sizes: letter, legal, A4, #10 or European envelopes, A5, B5, 11" x 17" ■ Software: Canon Creative V2.0 CD-ROMs—create brochures, labels, business cards, flyers, picture frames, T-shirts and more ■ 1-year InstantExchange warranty program

Canon®

NEW!

Wide carriage 11"x17"

\$499.00 CDW 72598

BJC-620 Color Bubble Jet™ printer

**The ultimate
in color printing**

■ 720 x 720 dpi ■ 1.7 ppm color print speed ■ 3 ppm black and white print speed ■ 300+ TrueType™ fonts on CD-ROM, 7 resident bitmap fonts ■ Canon Creative V2.0 CD-ROMs—offers easy-to-use tools to help make small and home businesses look professional ■ Microsoft® Windows® Printing system ■ 1-year InstantExchange warranty program

NEW!

\$399.00 CDW 72597

BJC-240 Color Bubble Jet™ printer

**Amazing color for
everything you do**

■ 360 x 360 ■ 0.27 ppm color print speed ■ 4 ppm black and white print speed ■ 300+ TrueType™ fonts, 7 resident bitmap fonts ■ Canon Creative V2.0 CD-ROMs—create brochures, labels, business cards, flyers, picture frames, T-shirts and more ■ Color Advisor V2.0, Visual Guide, Super Solver software ■ 1-year InstantExchange warranty program

NEW!

\$179.00 CDW 72589

BJC-4200 Color Bubble Jet™ printer

**Professional
performance
for your office or home**

■ 720 x 360 dpi ■ 5 ppm black and white print speed ■ 1 ppm color print speed ■ Fonts: 300+ TrueType™, 7 resident fonts ■ Includes Canon Creative V2.0 CD-ROM—create brochures, labels, business cards, flyers, picture frames, T-shirts and more ■ Optional Photo Kit produces photo-realistic color output ■ Optional tri-color neon ink cartridge ■ 1-year InstantExchange warranty program



\$279.00 CDW 72596

BJC-4100

\$229.00 CDW 58843

* A \$50 value! BC-22 Photo Ink Kit produces photo-realistic color output; includes Photo BJ cartridge, storage box and 60 sheets High Resolution paper.

MultIPASS C2500

**Canon Convertible™
color printer for
your home office**

Canon's MultiPASS C2500 is a state-of-the-art Color Bubble Jet™ printer that offers built-in fully-featured plain paper faxing, convenience copying and scanning to complete a home office.



Bubble Jet™ printer

■ 720 x 360 dpi ■ 5 ppm print speed in black and white ■ 0.3 to 0.8 ppm in color ■ 150 sheet paper capacity ■ Supports envelopes, transparencies, fabric sheets, T-shirt transfers

Plain paper fax

■ Maximum resolution: 203 x 196 fine print, 203 x 96 standard, UHQ and 64 shades of gray ■ 6 seconds per page print speed ■ 42 page print memory

Copier

■ Up to 99 copies ■ 360 dpi resolution with smoothing

Scanner

■ Resolution: 200 dpi ■ Software included: Desktop Manager V1.3, Canon Creative V2.0 CD-ROM ■ 2-year InstantExchange warranty program

\$599.00 CDW 67252

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FREE! YOU'VE GOT TO SEE IT IN **EPSON** COLOR.

Software bundle with Stylus Color 200 and 500, Stylus 1500 and Stylus Pro inkjet printers

LOOK YOUR BEST COLOR PAK V2.0

Includes: ▼ Full version of Sierra® Print Artist™ V3.0 and Adobe® PhotoDeluxe™ for PC
▼ FUNTASTIC Fonts, Outrageous Iron-on Art and Fab Photos
▼ Jump Start Guide, Color Tips booklet, valuable coupons for Epson products and more!

Offer valid through 1/31/97.

EPSON Stylus Color 200

With new Super-Penetrating color ink for richer, more vibrant color on all media

- ▼ 720 dpi (360 dpi on a 720 dpi matrix)
- ▼ Up to 2.5 ppm black text (360x 360 dpi)
- ▼ Compatible with all Windows® and TrueType™ fonts
- ▼ 100 sheet multi-size paper tray
- ▼ Paper sizes: letter, legal, A4, statement, executive, user definable
- ▼ IEEE-1284 parallel interface
- ▼ 2-year limited warranty

\$179.00 CDW 74726

EPSON Stylus Pro

The next step in color inkjet printers

- ▼ Maximum resolution: 720 x 720 dpi in black or color on plain paper with Microdot technology
- ▼ Maximum print speed: 3 ppm black printing, 1 ppm color printing
- ▼ Paper sizes: letter, legal, A4, B5, statement, executive ▼ Parallel and serial interfaces ▼ PC and Macintosh compatible
- ▼ Networkable—optional Ethernet or LocalTalk interface cards available ▼ 2-year limited warranty

\$379.00 CDW 57352

EPSON

EPSON Stylus Color 500

Award-winning Photo Quality color printing for today's office

- ▼ Up to 4 ppm black text (360 x 360 dpi) ▼ ESC/P 2 and IBM® X24/X24E emulation ▼ Prints brilliantly on any type of paper
- ▼ Compatible with all Windows®, TrueType™ and Adobe® fonts
- ▼ Paper sizes: letter, legal, A4, B5, statement, executive, user definable ▼ IEEE-1284 parallel, serial connectivity
- ▼ 2-year limited warranty

\$279.00

CDW 73069

EPSON Stylus 1500

The perfect color inkjet printer for a variety of needs

The Epson Stylus 1500 accepts continuous and single sheet paper simultaneously, making printing on envelopes, labels, transparencies and paper stock a breeze. Adjust the built-in feeder to handle everything from 4" x 4" index cards to C-size (17" x 22") paper stock.

- ▼ Up to 720 x 720 dpi ▼ 4-color photographic printing with true laser quality black ▼ 400 cps (characters per second) draft mode ▼ 200 cps letter quality mode ▼ 100 sheet paper tray capacity ▼ Tractor included ▼ Bi-directional parallel interface ▼ 2-year limited warranty

\$995.00 CDW 66369

EPSON DOT MATRIX PRINTERS

Model	Carriage width	Pins	Features	CPS HS draft	CPS draft/utility	CPS NLO	CPS LQ	CDW price	CDW
LX-300	normal	9	Optional color		264	53		\$167.09	30520
FX-870	normal	9	Handles 4-part forms	380	342	68		\$289.45	24585
FX-2170	wide	9	Handles 6-part forms	440	396	79		\$499.00	62768
LQ-2070	wide	24	8 built-in bar codes; extended ribbon life	300	275		92	\$383.04	73073
LQ-2170+	wide	24	Handles 5-part forms	440	396		132	\$599.00	62773
DFX-5000+	wide	9	Dual paper paths	560	504	101		\$1385.48	38206

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HP DeskJet 400 printer

Affordable, personal printer

- ◆ Resolution: 600 x 300 dpi black, 300 x 300 dpi color
- ◆ 3 ppm black print speed
- ◆ 3 ppm color print speed
- ◆ 16KB RAM ◆ 48KB input buffer ◆ Emulation: HP PCL Level 3 ◆ Fonts: Courier bitmap; GC Times and Letter Gothic (portrait only) ◆ Paper sizes: 7.35" x 10.5" to 8.5" x 14" ◆ Envelopes, transparencies and HP premium media ◆ 1-year limited warranty ◆ HP C2642A



\$199.98 CDW 72181

HP LaserJet 5L Xtra printer

Ultimate professional personal printing

- ◆ 600 x 600 dpi ◆ 4ppm print speed ◆ Emulation: Enhanced HP PCL 5, with 26 TrueType scalable fonts ◆ Memory: 1MB standard, 9MB maximum ◆ One 100-sheet paper input bin with single sheet priority feed slot ◆ Prints on letter, legal, A4, A5, executive, envelopes, transparencies, card stock, postcards, and labels ◆ 1-year warranty ◆ HP C3941C



\$429.00* CDW 71446

*After \$50 mail-in manufacturer's rebate. Offer valid through 12/31/96.

- HP LaserJet 5P printer HP C3150A **\$796.71** CDW 52178
◆ 600 x 600 dpi ◆ 6 ppm

HP DeskJet 870Cse printer

Sharp text, flexible connections and brilliant color

- ◆ Resolution: 600 x 600 dpi black, 600 x 300 dpi C-RET color ◆ 4 ppm black print speed, 1ppm color print speed ◆ 20MHz RISC processor ◆ Memory: 0.5MB built-in RAM, 32KB receive buffer ◆ Emulation and fonts: HP PCL Level 3, 26 built-in scalable fonts, 27 TrueType fonts for Macintosh, 126 TrueType fonts for Windows ◆ Interfaces: RS-422 serial, AppleTalk™ high-speed serial, Centronics parallel, IEEE 1284 compliant with 1284-B receptacle ◆ 1-year warranty ◆ HP C4565A



\$499.00 CDW 72326



HP DeskJet 682C printer

Featuring HP's Home Project Kit with banner capability and enhanced color

The HP 682C printer is the perfect color printer for fun family projects. It features the HP Home Project Kit with Disney's Mickey and Friends Print Studio and PrintPaks' Family Fun Pak for

creating window art, banners, magnets and more! The Home Project Kit also includes HP banner paper, greeting card stock and envelopes.

- ◆ Resolution: 600 x 600 dpi in black and white, 300 x 300 dpi color ◆ Print speed: 5 ppm maximum (black), 1.5 ppm (color) ◆ Emulation: HP PCL Level 3, with 8 built-in fonts and TrueType fonts ◆ Memory: 512KB RAM, 32KB receive buffer ◆ Paper sizes: letter, legal, executive, A4, transparencies, envelopes, banner, index cards ◆ Paper handling: 100 sheet paper tray, 50 sheet out tray capacity; banner, continuous feed up to 20 sheets ◆ 1-year limited warranty ◆ HP C4567A



\$299.00 CDW 86445

HP DeskJet 340 Portable Inkjet Printer

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- Up to 5 ppm black print speed
- Host-based Windows™ fonts
- Paper sizes: letter, legal, A4, B5, envelopes, index cards, transparencies, iron-on T-shirt transfer sheets, heavy card stock for greeting cards
- High speed parallel interface (IEEE 1284 compliant cable required)
- Software: Lexmark Workshop CD-ROM™ — Monotype GreetingCardMaker™, Monotype CertificateMaker™, Monotype T-ShirtDesignMaker™, SoftKey™ Labels Unlimited™, EarthLink Network TotalAccess™ and Comic Creator™
- Super Sharp Waterproof™ black ink and vivid color cartridges
- Starter paper pack
- ColorFine™ 2 driver is designed for Windows V3.1, V3.11 and Windows 95; it also prints DOS® applications running under Windows
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- Host-based Windows™ fonts
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- High speed parallel interface, (IEEE 1284 compliant cable required)
- Lexmark Workshop CD-ROM — Monotype GreetingCardMaker™, Monotype CertificateMaker™, Monotype T-ShirtDesignMaker™, SoftKey™ Labels Unlimited™, EarthLink Network Total Access™, and Comic Creator™
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ML591	wide	24	optional color	450	360	120	—	\$603.67	24900
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ronment variable is difficult, so the batch file simply tests each possible value in turn. If the move is acceptable, execution jumps to the label Check.

At the label Check, the variable representing the selected square is assigned the value X or O, depending on whose turn it is. (The batch file is set up for the X player to start.) Then the batch file just slogs through the eight possible rows to see if the player has won. If there's no winner at the ninth move, the pro-

gram reports a tie. Otherwise, it sets the environment variable turn to X if it was O, or to O if it was X. Now the whole process starts over again, getting the O player's input.

If the batch file is invoked with an exclamation mark on the command line, the computer takes over for the O player. The batch file COMPPLAY.BAT (Figure 2) determines the logical move for the computer to make.

COMPPLAY.BAT is a bit more complex than TIC-TAC.BAT. It starts with some special-case

processing for the second and fourth moves. On the second move, the program takes the center if possible, a corner if not. And on the fourth move, the program blocks the X player from getting a two-way, three-in-a-row fork. Then it crunches through all the possible moves until it finds one worth playing. The program examines each vacant square and checks the contents of the other two squares in the same horizontal, vertical, and diagonal rows. If it finds two O's in the same row, the pro-

```
@echo off
:: TIC-TAC.BAT - A Tic-Tac-Toe game (batch file)
:: To play against computer, put ! on command line
:Startup
set turn=X
FOR %%v IN (trnct wmsg mv) DO set %%v=
FOR %%v IN (1 2 3 4 5 6 7 8 9) DO SET sq%%v=-
:Top
:: - = Alt+196, | = Alt+179, + = Alt+197
cls
echo:          Tic-Tac-Toe
echo:
echo: 1          | 2          | 3
echo: %sq1%      | %sq2%      | %sq3%
echo:          |          |
echo:-----+-----+-----
echo: 4          | 5          | 6
echo: %sq4%      | %sq5%      | %sq6%
echo:          |          |
echo:-----+-----+-----
echo: 7          | 8          | 9
echo: %sq7%      | %sq8%      | %sq9%
echo:          |          |
echo:
echo:          Q - Quit
echo:
echo:It is %turn% turn. %wmsg%
echo:
if not '%wmsg%'==' ' goto NewGame
if '%1'=='!' IF '%turn%'=='O' GOTO CompPlay
choice Pick a Square (1-9):/N/C123456789Q
FOR %%v IN (1 2 3 4 5 6 7 8 9 10) DO if errorlevel %%v
-set mv=%%v

if '%mv%'=='10' GOTO TheEnd
if '%mv%'=='9' if not '%sq9%'=='-' goto Oops
if '%mv%'=='8' if not '%sq8%'=='-' goto Oops
if '%mv%'=='7' if not '%sq7%'=='-' goto Oops
if '%mv%'=='6' if not '%sq6%'=='-' goto Oops
if '%mv%'=='5' if not '%sq5%'=='-' goto Oops
if '%mv%'=='4' if not '%sq4%'=='-' goto Oops
if '%mv%'=='3' if not '%sq3%'=='-' goto Oops
if '%mv%'=='2' if not '%sq2%'=='-' goto Oops
if '%mv%'=='1' if not '%sq1%'=='-' goto Oops
GOTO Check

:CompPlay
echo:Press a key to see computer's move
```

```
pause>nul
call compplay.bat

:Check
set sq%mv%=%turn%
set trnct=%trnct%1
:: Row win?
if '%sq1%%sq2%%sq3%'=='%turn%%turn%%turn%' GOTO Winner
if '%sq4%%sq5%%sq6%'=='%turn%%turn%%turn%' GOTO Winner
if '%sq7%%sq8%%sq9%'=='%turn%%turn%%turn%' GOTO Winner
:: Column win?
if '%sq1%%sq4%%sq7%'=='%turn%%turn%%turn%' GOTO Winner
if '%sq2%%sq5%%sq8%'=='%turn%%turn%%turn%' GOTO Winner
if '%sq3%%sq6%%sq9%'=='%turn%%turn%%turn%' GOTO Winner
:: Diagonal win?
if '%sq1%%sq5%%sq9%'=='%turn%%turn%%turn%' GOTO Winner
if '%sq3%%sq5%%sq7%'=='%turn%%turn%%turn%' GOTO Winner
if '%trnct%'=='111111111' goto XOTie
if '%turn%'=='X' set turn=Z
if '%turn%'=='O' set turn=X
if '%turn%'=='Z' set turn=O
goto Top

:Winner
set wmsg='%turn%' has won the game
goto Top

:XOTie
set wmsg= 'X' and 'O' have tied
goto Top

:NewGame
choice Another Game
if errorlevel 2 GOTO TheEnd
if errorlevel 1 GOTO StartUp
goto TheEnd

:Oops
::Beep
:: v-- Ctrl+G (ASCII character 7)
echo: ^G
goto Top

:TheEnd
echo:Quitting Tic-Tac-Toe.
for %%v IN (turn trnct wmsg mv) DO set %%v=
for %%v IN (1 2 3 4 5 6 7 8 9 0) DO set sq%%v=-
```

FIGURE 1: This batch file implements the game Tic-Tac-Toe, using the CHOICE command to get input from the player; when the program is started with an exclamation point on the command line, the computer takes the part of the O player.

gram immediately plays the vacant square and wins. If there's no immediate win, the program checks for a vacant square in line with two X's and plays there to block a win by X. If no blocking is required, it seeks a vacant square that is in line with an O and another vacant square—a potential win. And if all else fails, the program just plays in the first vacant square.

The process of checking all possible rows is repeated over and over, so COMPLAY.BAT uses an internal subroutine for that. This subroutine begins at the label Test and ends with the command GOTO Ret%sought%. To test

whether there is a vacant square in line with two O's, the batch file sets the variable named sought to OO and jumps to the label Test. If one of the tests succeeds, the secondary batch file terminates, with the variable mv set to the computer's move. Otherwise, the last line of the subroutine jumps to the label RetOO. Each call to this subroutine consists of three lines, one to set the value of sought, one to jump to the subroutine, and a label consisting of "Ret" plus the current value of sought. So, for example, these three lines check for a blocking move:

```
set sought=XX
goto Test
:RetXX
```

Your work almost certainly won't require you to write a Tic-Tac-Toe game in the batch language. But you can apply the techniques used here to enhance and streamline your own batch files.

You can download these batch files from PC Magazine Online. For downloading instructions, refer to the sidebar "Guide to Our Utilities" in this issue's Utilities column.

```
@echo off
if NOT '%trnct%'=='1' GOTO NotSecond
:: On 2d move, take center if possible, corner if not
set mv=7
if '%sq5%'=='-' set mv=5
GOTO End
:NotSecond
IF NOT '%trnct%'=='111' GOTO NotFourth
:: On 4th move, avoid two-way fork
set mv=4
IF '%sq1%sq9%'=='XX' goto End
IF '%sq3%sq7%'=='XX' goto End
set mv=1
IF '%sq1%'=='-' if '%sq4%sq2%'=='XX' goto End
set mv=3
IF '%sq3%'=='-' if '%sq2%sq6%'=='XX' goto End
set mv=7
IF '%sq7%'=='-' if '%sq8%sq4%'=='XX' goto End
set mv=9
IF '%sq9%'=='-' if '%sq6%sq8%'=='XX' goto End
:NotFourth
:: Check for a winning move
set sought=OO
goto Test
:RetOO

:: Check for a blocking move
set sought=XX
goto Test
:RetXX

:: Check for row with one O and two blank
set sought=-O
goto Test
:Ret-O
set sought=O-
goto Test
:RetO-

:: Nothing? Just pick first unused square
set mv=1
if '%sq1%'=='-' GOTO End
set mv=2
if '%sq2%'=='-' GOTO End
set mv=3
if '%sq3%'=='-' GOTO End
```

```
set mv=4
if '%sq4%'=='-' GOTO End
set mv=6
if '%sq6%'=='-' GOTO End
set mv=7
if '%sq7%'=='-' GOTO End
set mv=8
if '%sq8%'=='-' GOTO End
set mv=9
GOTO End

:Test
set mv=1
if '%sq1%'=='-' if '%sq2%sq3%'=='%sought%' GOTO End
if '%sq1%'=='-' if '%sq4%sq7%'=='%sought%' GOTO End
if '%sq1%'=='-' if '%sq5%sq9%'=='%sought%' GOTO End
set mv=3
if '%sq3%'=='-' if '%sq1%sq2%'=='%sought%' GOTO End
if '%sq3%'=='-' if '%sq6%sq9%'=='%sought%' GOTO End
if '%sq3%'=='-' if '%sq5%sq7%'=='%sought%' GOTO End
set mv=7
if '%sq7%'=='-' if '%sq8%sq9%'=='%sought%' GOTO End
if '%sq7%'=='-' if '%sq1%sq4%'=='%sought%' GOTO End
if '%sq7%'=='-' if '%sq5%sq3%'=='%sought%' GOTO End
set mv=9
if '%sq9%'=='-' if '%sq7%sq8%'=='%sought%' GOTO End
if '%sq9%'=='-' if '%sq3%sq6%'=='%sought%' GOTO End
if '%sq9%'=='-' if '%sq1%sq5%'=='%sought%' GOTO End
set mv=2
if '%sq2%'=='-' if '%sq1%sq3%'=='%sought%' GOTO End
if '%sq2%'=='-' if '%sq5%sq8%'=='%sought%' GOTO End
if '%sq4%'=='-' if '%sq5%sq6%'=='%sought%' GOTO End
if '%sq4%'=='-' if '%sq1%sq7%'=='%sought%' GOTO End
set mv=6
if '%sq6%'=='-' if '%sq4%sq5%'=='%sought%' GOTO End
if '%sq6%'=='-' if '%sq3%sq9%'=='%sought%' GOTO End
set mv=8
if '%sq8%'=='-' if '%sq7%sq9%'=='%sought%' GOTO End
if '%sq8%'=='-' if '%sq2%sq5%'=='%sought%' GOTO End
goto Ret%sought%

:End
set sought=
```

FIGURE 2: This batch file calculates the best move in Tic-Tac-Toe. The computer takes the part of the O player.



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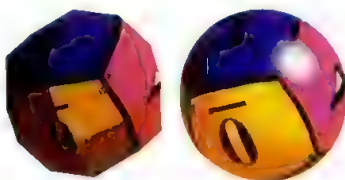
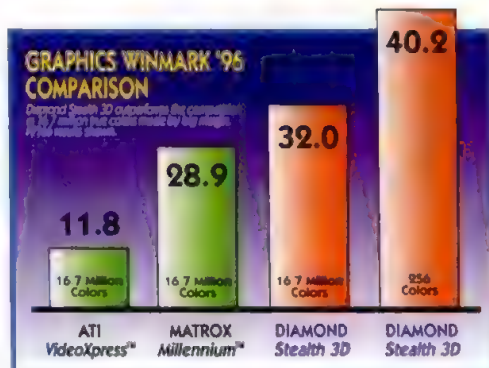
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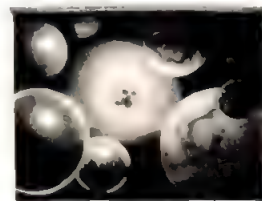
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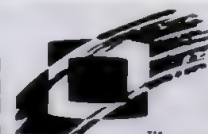
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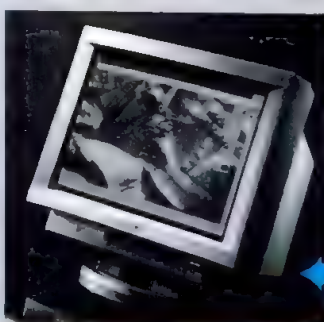
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Pushing Up Daisies?



I have a Tandy DWP-210 daisy wheel printer (circa 1985) that has served me faithfully over the years. I recently bought a new Pentium/133 computer system that came with Windows 95 preinstalled, and there is no driver for this printer. All of the available printer drivers seem to be for dot matrix printers. Where can I find a suitable driver for this printer?

EDWARD WOLAK
Chicago, Illinois

PC MAGAZINE: Many users hang on to their daisy wheel printers because they like the print quality they get from the fully formed characters (and you can make a carbon copy on a daisy wheel, which you can't do with a laser or ink jet printer). The good news is that a suitable driver for your printer is built right into Windows 95. The bad news is that your printer is not really suitable for the software.

First, the good news: Just as Windows 3.x does, Windows 95 includes a driver that you

can hand-configure for most older printers, including dot matrixes and daisy wheels. To access it, choose Settings from the Start menu, then Printers, then Add New Printer. When you reach the screen that asks for the Manufacturer and Printer you wish to install, choose Generic for the manufacturer and Generic/Text Only for the printer.

After the printer is installed, you can then open its Properties window, where you'll find tabs for Device Options and Fonts. These two screens let you enter the escape command sequences for different features, and you can map the higher-order ASCII characters to specific characters on the printer. The font effects are easy to define; simply press the Esc key to enter an escape character in the command sequence. These screens also let you define different command sets and save the settings with different names. This makes it possible to have different character mappings for different printwheels, for example. So while the driver is named Generic, you can actually do a lot to customize it to take advantage of your printer's capabilities.

The downside of all this is that your printer can only print in one font at a time, and it can't

do graphics at all. You may not get the same line breaks and formatting on the page as you see on the screen if you do not use the right fonts within Windows. This means that you miss out entirely on the TrueType fonts that give Windows so much typographical flexibility. Furthermore, Windows is a graphical interface, and much of the information presented by its programs are graphics. A daisy wheel cannot reproduce these graphics.

If you truly want to stick with the daisy wheel output of your existing printer, you should at least consider adding an inexpensive color ink jet printer to your system configuration. It would give you the opportunity to print the graphical pages that your daisy wheel cannot produce, and you may find that you like some of the other advantages Windows printing has to offer.—*Alfred Poor*

A Logical Display

After accidentally erasing my hard disk, I reinstalled Windows 95. Now I can't get my display to work properly. Before the accident, I had the display configured for 256 colors at 800-by-600 resolution. Now it automatically switches to 16 colors if I choose 800-by-600. The computer manufacturer told me to get the CL-GD5428 driver from Cirrus Logic, but Cirrus Logic

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C39804

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Model	Resolution (dpi)* Black/Color	Maximum Paper Size	Dimensions HxWxD	B&W/Color PPM	Fonts Fixed/Scalable	Flex P/N	Flex Price
DeskJet 340	600x300/600x300	8.5x14	5.9x12.2x3.7	3	6/NA	C2655A	\$309
DeskJet 400C	600/600x300	8.5x14	8x17x16	4/1	NA/14	C4547A	\$199
DeskJet 680C	600/600x300	8.5x14	8x17x16	5/1.5	8/14	C4549A	\$299
DeskJet 820Cxi	600/600x300	8.5x14	8.9x17.5x16	6.5/4	NA/50	C4531A	\$379
DeskJet 870Cxi	600/600x300	8.5x14	8.9x17.5x16	7/3	8/14	C4555A	\$469
DeskJet 1600C	600/300	8.5x14	11x20x17	9	NA/35	C3540A	\$1269
DeskJet 1600CM	600/300	8.5x14	11x20x17	9	NA35	C3541A	\$1849

*Maximum resolution may require special paper

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BJC-70	Tri-Color Ink	720x360/360	35KB	11.8x2.2x6.2	1-3	27	2 Yr	BI-BJC70	\$299
BJC-240	Tri-Color Ink	720x360/360	60KB	14.2x6.8x8.5	4-27	300+	1 Yr	BI-BJC240	\$179
BJC-4100	Tri-Color Ink	720x360/200x300	64KB	14.4x8.8x7.8	4-8	300+	2 Yr	BI-BJC4100	CALL
BJC-4200	Tri-Color Ink	720x360/200x300	64KB	15.1x7.5x11.5	5/1	300+	1 Yr	BI-BJC4200	\$279
BJC-610	Separate Ink	720/20	60KB	16.1x7.2x10	1-3/2	300+	2 Yr	BI-BJC610	\$369
BJC-620	Separate Ink	720/20	60KB	16.1x7.2x10	1-7/3	300+	1 Yr	BI-BJC620	\$399
LBP-465	Laser	600/NA	256KB	13.2x9.8x12.6	4	300+	3 Yr	BI-LBP465	\$359

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C199011

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Stylus 1500	720/720	17x22	26x20x8	3	6	4	2 Yr.	C172001	\$995
Stylus Pro XL	720*/720*	13x19	22.8x23.5x7.2	3	5	4	2 Yr.	EPSCOLOR-XL	\$1799

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4078001



told me that its drivers are already on the Windows 95 CD-ROM. How can I return my resolution to what I want it to be?

JOHNPAUL PERRY
Coral Springs, Florida

PC MAGAZINE: It sounds as if your computer didn't correctly identify your graphics card automatically; it may have chosen the wrong driver. The procedure outlined below should help you verify whether you have the correct driver loaded, and if you don't, how to get the right one installed.

The Windows 95 CD-ROM does indeed include a number of drivers for the Cirrus Logic chips. None are specifically for the 5428 chip, but the general Cirrus driver should work for you. This driver supports 16-, 256-, 65,536-, and 16,700,000-color modes for 640-by-480 and 800-by-600 resolutions. (The driver also supports 1,024-by-768 but will not go up to 16,700,000 colors at that resolution.)

The best way to make sure you have the correct driver loaded is to open the Device Manager window within the Control Panel's System applet. Click on the plus sign next to the Display Adapter icon, then highlight the display adapter line that appears below that line. Select Properties, and then the Driver tab in the Properties window. If you click on the Change Driver button, you'll see a list of the drivers that Windows thinks are compatible with the card that is installed. If you choose the Show All Devices button, the full list of available drivers will be displayed, and you can pick one according to the name of the manufacturer.—*Alfred Poor*

OPERATING ENVIRONMENTS

Accented Characters In E-Mail



I recently sent an e-mail message written in Spanish. To create the accented characters, I used the U.S.-International keyboard layout that comes with Windows 3.1. Unfortunately, the accented characters did not show up correctly on the recipient's computer screen; in their place appeared a bunch of strange characters. What is going on here? Isn't it possible to send e-mail text with accented characters? Any way around the problem?

MICHAEL SPECTOR
via the Internet

PC MAGAZINE: Our computers display text characters on the screen, but internally, they use an 8-bit coding scheme that encodes each character into a number from 0 to 255. The problem you've encountered is due to the fact that multiple standards exist for encoding characters as numbers. Extended ASCII encoding, used by DOS programs, and ANSI

encoding, used by Windows programs, are the same for the first 128 characters. Unfortunately, all accented characters fall into the second 128 characters, and here the two coding systems differ wildly. If a message is composed using ASCII and read using ANSI (or vice versa), the results can be very strange indeed.

Take the character —, for example. This is character number 165 in the ASCII set, and it will be encoded as the number 165. When the message is read using the ANSI character set, that same number represents the yen symbol, ¥. Going the other way, the character Ò is number 241 in the ANSI character set. That same number in the ASCII set is the symbol ±. Worse yet, a configuration or transmission error can occasionally strip the high bit from each character, replacing the accented characters with the character whose number is less by 128. Character 241, the ANSI Ò, would become 113 (241 minus 128)—the letter q in either encoding.

Eventually, we're told, all the world's computer systems will use Unicode, which devotes 16 bits instead of 8 to each character. With 65,536 possible values, Unicode has enough numbers to represent all the characters of all modern, character-based languages, along with many other symbols. Until that happy day, we just have to work around the problem. Perhaps you can arrange to have your correspondents use the same character set you're using. Consider sending messages that contain accented characters as binary attachments. If all else fails, you can fall back on an old-timer's trick and write each accent (or similar punctuation mark) after the character with which it's associated. For example: *deja' vu*, *nin-o*, *u"ber*. It's not pretty, but the meaning does come through.—*Neil J. Rubenking*

Making EPM the Default Editor in OS/2

Is there any way to make EPM the standard text editor under OS/2? I can't seem to find any information on how to override OS/2's default system editor. Any help would be appreciated.

JOHN THOMSON
via CompuServe

PC MAGAZINE: The OS/2 Enhanced Editor (EPM) does have some advantages over the System Editor. The procedure to make the EPM the default editor also demonstrates how to modify other system associations.

The first step is to establish EPM's association with text files. Open the OS/2 System fold-

er and, within that, the Productivity folder, in order to find the Enhanced Editor icon. Right-click on the icon and select Settings from the pop-up menu. When the Settings Notebook opens, click on the Association tab to see the view shown in Figure 1.

Scroll through the list of Available Types and select the entries for which you'd like EPM to be the default. Click on the Add>> button, and those types will be moved to the list on the right, labeled Current Types. You will probably want to select DOS Command Files, OS/2 Command Files, and Plain Text file types.

But this procedure handles only files that have had a specific type assigned to them and stored in their extended attributes. Many text files don't have a type assigned, so one more step is needed. Move to the lower half of the

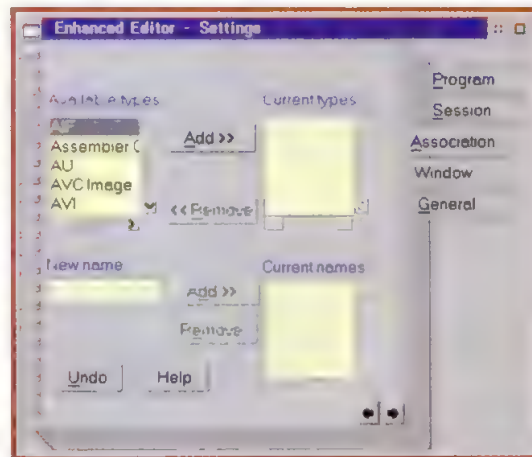


FIGURE 1: Changing the Enhanced Editor's associations in the Settings Notebook.

page to the New Name field. Here, you can associate EPM with files based on their extensions. For example, type *.TXT and click on the Add>> button next to the New Name field. Now files whose names end with .TXT are associated with the enhanced editor. You may wish to add other file extensions, such as *.CMD and *.BAT. When you're finished, close the Settings Notebook.

You're halfway there. If you right-click on a text file's icon and click on the arrow beside Open in the pop-up menu, you can now choose between the System Editor or the Enhanced Editor (as shown in Figure 2). But the check mark beside System Editor indicates that it is still the default program, meaning that if you simply double-click on the file's icon, the System Editor is the program that is loaded. To make the Enhanced Editor the default, you need to open the OS/2 System folder and, within that, the Productivity folder—this time, to find the System Editor icon. Now open the System Editor's Settings Notebook and go to the Associations page, just as you did for the Enhanced Editor.

This time, you want to select the entries in



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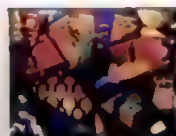
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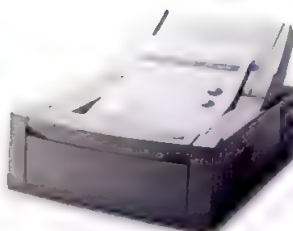
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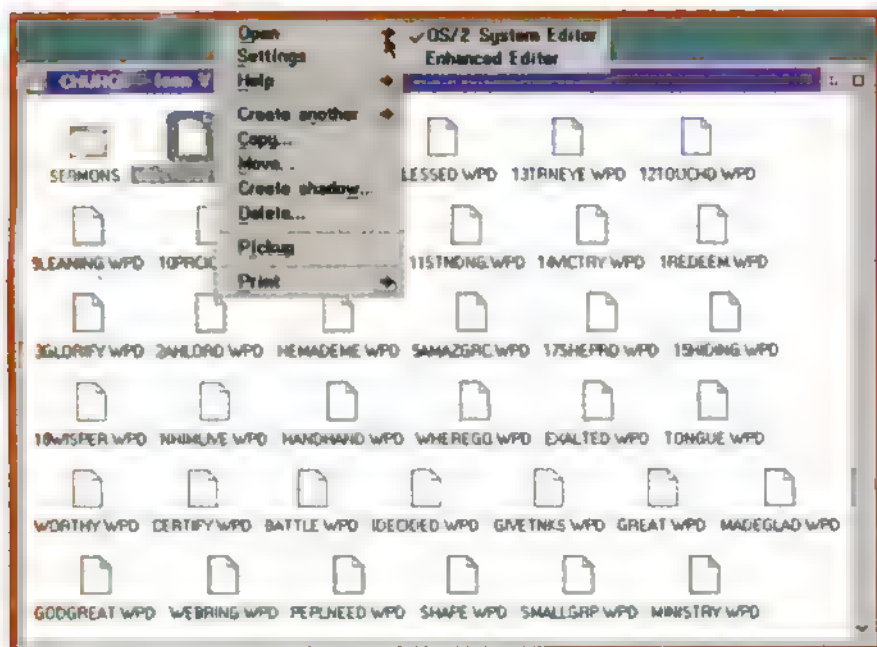


FIGURE 2: The Enhanced Editor has been added to an object's Open list, but the OS/2 System Editor is still the default.

the Current Types and Current Names entries and click on the <<Remove button, so that the System Editor is no longer associated with them. When you close the Settings Notebook, the transition is complete. The Enhanced Editor is now the only entry in the Open list for file objects, and it should have the check mark indicating that it is the default program. —Brian Proffit

WORD PROCESSING

Double Strike and the Windows Generic Printer Driver



In your issue of February 20, 1996, a reader asked how he could still use double-striking after moving to Windows, since the Windows driver for his printer doesn't support double-striking. You suggested that he edit the file in a Windows word processor but print it from his old DOS word processor. Obviously, it would be preferable to print from Windows—and I believe there is a way to do so.

Windows comes with a Generic/Text Only printer driver that allows for some custom configuration, such as defining the control codes for special characters. When you define the control codes, you can send any you like. That means you can define the yen character, say, with the escape code to turn on double strike, and the mu character with the code to turn off double strike. You can then enter the characters in your document to turn the feature on and off. To enter yen, turn on NumLock, hold down the Alt key, enter either 157 or 0165 on the numeric keypad, and release the Alt key. To enter mu, follow the same procedure but use either 230 or 0181.

I haven't tested this for double strike, because my printer doesn't support that feature. But I have tested it with my printer's double-

wide feature, and it certainly works for that.

ERIC L. VAN DUSEN
Pasadena, California

PC MAGAZINE: In my response to the letter printed in our issue of February 20, 1996, I pointed out to the reader that though several ways to solve his problem existed, printing from a DOS word processor was the most reliable one. Enough people suggested this particular alternative to make the question worth revisiting—especially since the generic print driver is worth drawing attention to in any case.

The good news is that you can use the generic print driver this way with most of the print enhancements your printer offers. The bad news is that this trick won't work for the double-strike feature in many printers. The Diablo command set, which many daisy wheel printers follow, turns off double strike every time it sees a carriage return. This means you'd have to turn the feature back on at the beginning of each new line of text.

To define a code in the Generic/Text Only printer driver for Windows 3.x, open the Control Panel, choose printers, highlight the Generic/Text Only printer choice (assuming it's already installed), choose Setup, and then click on the Characters button. Highlight the character you want to use for any given code in the On Screen list box, then enter the code in the On Printer text box. To enter an escape, simply hit the Esc key.

To define a code in the Generic/Text Only printer driver for Windows 95, choose Start | Settings | Printers, then double-click on the Generic/Text Only printer icon (assuming, once again, that that printer's already installed). In the Generic/Text Only dialog box, Choose File | Properties, then go to the Device Options card. Here again, you can highlight the character you want to use in the On Screen list box, then enter the code in the On Printer text box. In either case, once you've defined the code, you can use the appropriate characters to turn a feature on or off.—M. David Stone

SPREADSHEETS

Converting Integers to Dates



I needed to convert about a thousand three- and four-digit integers to dates in Excel, and then export the resulting dates to a Lotus 1-2-3 for DOS worksheet. For example, if my original data contained a number like 876, I had to find a way to

convert it to 8/76, meaning August 1976.

I tried custom-formatting the number with the formatting code #0"/"00. This was easy, and it made the numbers look right in Excel, but when I sent the worksheet to 1-2-3, 8/76 became 876 again.

Then I tried the following (assume the unprocessed number is in A1):

```
=TEXT(TRUNC(A1/100,0),"#0")&"/"&TEXT  
  (MOD(A1,100),"##")
```

This worked, but it occurred to me that since I was using the TEXT function here, it might be wiser if I first formatted the original number as text and then broke it down. So first I assigned Excel's Text format to my integer, and then I applied the following formula:

```
=IF(LEN(A1)=3,LEFT(A1,1),LEFT(A1,2))&  
  "/"&RIGHT(A1,2)
```

Sure enough, this was simpler! When I was done, I copied the formula into all thousand or so cells, copied the cells containing the formulas, did a Paste Special Values over the original integers, and then sent the whole works back to 1-2-3.

I'm still wondering, though. Is there a simpler way?

LUCY CHAN
Brooklyn, New York

PC MAGAZINE: Yes, somewhat. Converting the integers to text, either by using the TEXT function or displaying the numbers with the Text format, is an unnecessary step. You could have simply written the following formula:

```
=TRUNC(A1/100,0)&"/"&MOD(A1,100)
```

This formula concatenates a piece of text (the slash character) with two numbers (the TRUNC number and the MOD number). But Excel doesn't care. Or, more precisely, Excel gets your drift and takes care of the number-to-text conversion for you.

Excel also understands that if this operation produces a result such as 8/76, that result is to be treated as a date. For example, if you apply the MONTH function to this result, you get 8; if you apply the YEAR function, you get 1976, and so on.

Ambiguity may arise if the result of this operation is something like 11/16. Is this November 16 or November 1916? Excel tries to make the number to the right of the slash a day value, as long as doing so yields a valid date. If it does not yield a valid date, Excel tries to treat the number to the right of the slash as a year.

In any case, because the program recognizes the formula's result as a date, it stores it internally as a serial date value and exports it appropriately to 1-2-3.—Craig Stinson

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128K 3.3V	13.00	13.00	13.00	13.00
256K 3.3V	13.00	13.00	13.00	13.00
256K 3.3V	13.00	13.00	13.00	13.00
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GB		90.8 GB		91.6 GB		92.4 GB		93.2 GB		94.0 GB		94.8 GB		95.6 GB		96.4 GB		97.2 GB		98.0 GB		98.8 GB		99.6 GB		100.0 GB		100.8 GB		101.6 GB		102.4 GB		103.2 GB		104.0 GB		104.8 GB		105.6 GB		106.4 GB		107.2 GB		108.0 GB		108.8 GB		109.6 GB		110.4 GB		111.2 GB		112.0 GB		112.8 GB		113.6 GB		114.4 GB		115.2 GB		116.0 GB		116.8 GB		117.6 GB		118.4 GB		119.2 GB		120.0 GB		120.8 GB		121.6 GB		122.4 GB		123.2 GB		124.0 GB		124.8 GB		125.6 GB		126.4 GB		127.2 GB		128.0 GB		128.8 GB		129.6 GB		130.4 GB		131.2 GB		132.0 GB		132.8 GB		133.6 GB		134.4 GB		135.2 GB		136.0 GB		136.8 GB		137.6 GB		138.4 GB		139.2 GB		140.0 GB		140.8 GB		141.6 GB		142.4 GB		143.2 GB		144.0 GB		144.8 GB		145.6 GB		146.4 GB		147.2 GB		148.0 GB		148.8 GB		149.6 GB		150.4 GB		151.2 GB		152.0 GB		152.8 GB		153.6 GB		154.4 GB		155.2 GB		156.0 GB		156.8 GB		157.6 GB		158.4 GB		159.2 GB		160.0 GB		160.8 GB		161.6 GB		162.4 GB		163.2 GB		164.0 GB		164.8 GB		165.6 GB		166.4 GB		167.2 GB		168.0 GB		168.8 GB		169.6 GB		170.4 GB		171.2 GB		172.0 GB		172.8 GB		173.6 GB		174.4 GB		175.2 GB		176.0 GB		176.8 GB		177.6 GB		178.4 GB		179.2 GB		180.0 GB		180.8 GB		181.6 GB		182.4 GB		183.2 GB		184.0 GB		184.8 GB		185.6 GB		186.4 GB		187.2 GB		188.0 GB		188.8 GB		189.6 GB		190.4 GB		191.2 GB		192.0 GB		192.8 GB		193.6 GB		194.4 GB		195.2 GB		196.0 GB		196.8 GB		197.6 GB		198.4 GB		199.2 GB		200.0 GB		200.8 GB		201.6 GB		202.4 GB		203.2 GB		204.0 GB		204.8 GB		205.6 GB		206.4 GB		207.2 GB		208.0 GB		208.8 GB		209.6 GB		210.4 GB		211.2 GB		212.0 GB		212.8 GB		213.6 GB		214.4 GB		215.2 GB		216.0 GB		216.8 GB		217.6 GB		218.4 GB		219.2 GB		220.0 GB		220.8 GB		221.6 GB		222.4 GB		223.2 GB		224.0 GB		224.8 GB		225.6 GB		226.4 GB		227.2 GB		228.0 GB		228.8 GB		229.6 GB		230.4 GB		231.2 GB		232.0 GB		232.8 GB		233.6 GB		234.4 GB		235.2 GB		236.0 GB		236.8 GB		237.6 GB		238.4 GB		239.2 GB		240.0 GB		240.8 GB		241.6 GB		242.4 GB		243.2 GB		244.0 GB		244.8 GB		245.6 GB		246.4 GB		247.2 GB		248.0 GB		248.8 GB		249.6 GB		250.4 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GB		331.2 GB		332.0 GB		332.8 GB		333.6 GB		334.4 GB		335.2 GB		336.0 GB		336.8 GB		337.6 GB		338.4 GB		339.2 GB		340.0 GB		340.8 GB		341.6 GB		342.4 GB		343.2 GB		344.0 GB		344.8 GB		345.6 GB		346.4 GB		347.2 GB		348.0 GB		348.8 GB		349.6 GB		350.4 GB		351.2 GB		352.0 GB		352.8 GB		353.6 GB		354.4 GB		355.2 GB		356.0 GB		356.8 GB		357.6 GB		358.4 GB		359.2 GB		360.0 GB		360.8 GB		361.6 GB		362.4 GB		363.2 GB		364.0 GB		364.8 GB		365.6 GB		366.4 GB		367.2 GB		368.0 GB		368.8 GB		369.6 GB		370.4 GB		371.2 GB		372.0 GB		372.8 GB		373.6 GB		374.4 GB		375.2 GB		376.0 GB		376.8 GB		377.6 GB		378.4 GB		379.2 GB		380.0 GB		380.8 GB		381.6 GB		382.4 GB		383.2 GB		384.0 GB		384.8 GB		385.6 GB		386.4 GB		387.2 GB		388.0 GB		388.8 GB		389.6 GB		390.4 GB		391.2 GB		392.0 GB		392.8 GB		393.6 GB		394.4 GB		395.2 GB		396.0 GB		396.8 GB		397.6 GB		398.4 GB		399.2 GB		400.0 GB		400.8 GB		401.6 GB		402.4 GB		403.2 GB		404.0 GB		404.8 GB		405.6 GB		406.4 GB		407.2 GB		408.0 GB		408.8 GB		409.6 GB		410.4 GB		411.2 GB		412.0 GB		412.8 GB		413.6 GB		414.4 GB		415.2 GB		416.0 GB		416.8 GB		417.6 GB		418.4 GB		419.2 GB		420.0 GB		420.8 GB		421.6 GB		422.4 GB		423.2 GB		424.0 GB		424.8 GB		425.6 GB		426.4 GB		427.2 GB		428.0 GB		428.8 GB		429.6 GB		430.4 GB		431.2 GB		432.0 GB		432.8 GB		433.6 GB		434.4 GB		435.2 GB		436.0 GB		436.8 GB		437.6 GB		438.4 GB		439.2 GB		440.0 GB		440.8 GB		441.6 GB		442.4 GB		443.2 GB		444.0 GB		444.8 GB		445.6 GB		446.4 GB		447.2 GB		448.0 GB		448.8 GB		449.6 GB		450.4 GB		451.2 GB		452.0 GB		452.8 GB		453.6 GB		454.4 GB		455.2 GB		456.0 GB		456.8 GB		457.6 GB		458.4 GB		459.2 GB		460.0 GB		460.8 GB		461.6 GB		462.4 GB		463.2 GB		464.0 GB		464.8 GB		465.6 GB		466.4 GB		467.2 GB		468.0 GB		468.8 GB		469.6 GB		470.4 GB		471.2 GB		472.0 GB		472.8 GB		473.6 GB		474.4 GB		475.2 GB		476.0 GB		476.8 GB		477.6 GB		478.4 GB		479.2 GB		480.0 GB		480.8 GB		481.6 GB		482.4 GB		483.2 GB		484.0 GB		484.8 GB		485.6 GB		486.4 GB		487.2 GB		488.0 GB		488.8 GB		489.6 GB		490.4 GB		491.2 GB		492.0 GB		492.8 GB		493.6 GB		494.4 GB		495.2 GB		496.0 GB		496.8 GB		497.6 GB		498.4 GB		499.2 GB		500.0 GB		500.8 GB		501.6 GB		502.4 GB		503.2 GB		504.0 GB		504.8 GB		505.6 GB		506.4 GB		507.2 GB		508.0 GB		508.8 GB		509.6 GB		510.4 GB		511.2 GB		512.0 GB		512.8 GB		513.6 GB		514.4 GB		515.2 GB		516.0 GB		516.8 GB		517.6 GB		518.4 GB		519.2 GB		520.0 GB		520.8 GB		521.6 GB		522.4 GB		523.2 GB		524.0 GB		524.8 GB		525.6 GB		526.4 GB		527.2 GB		528.0 GB		528.8 GB		529.6 GB		530.4 GB		531.2 GB		532.0 GB		532.8 GB		533.6 GB		534.4 GB		535.2 GB		536.0 GB		536.8 GB		537.6 GB		538.4 GB		539.2 GB		540.0 GB		540.8 GB		541.6 GB		542.4 GB		543.2 GB		544.0 GB		544.8 GB		545.6 GB		546.4 GB		547.2 GB		548.0 GB		548.8 GB		549.6 GB		550.4 GB		551.2 GB		552.0 GB		552.8 GB		553.6 GB		554.4 GB		555.2 GB		556.0 GB		556.8 GB		557.6 GB		558.4 GB		559.2 GB		560.0 GB		560.8 GB		561.6 GB		562.4 GB		563.2 GB		564.0 GB		564.8 GB		565.6 GB		566.4 GB		567.2 GB		568.0 GB		568.8 GB		569.6 GB		570.4 GB		571.2 GB		572.0 GB		572.8 GB		573.6 GB		574.4 GB		575.2 GB		576.0 GB		576.8 GB		577.6 GB		578.4 GB		579.2 GB		580.0 GB		580.8 GB		581.6 GB		582.4 GB		583.2 GB		584.0 GB		584.8 GB		585.6 GB		586.4 GB		587.2 GB		588.0 GB		588.8 GB		589.6 GB		590.4 GB		591.2 GB		592.0 GB		592.8 GB		593.6 GB		594.4 GB		595.2 GB		596.0 GB		596.8 GB		597.6 GB		598.4 GB		599.2 GB		600.0 GB		600.8 GB		601.6 GB		602.4 GB		603.2 GB		604.0 GB		604.8 GB		605.6 GB		606.4 GB		607.2 GB		608.0 GB		608.8 GB		609.6 GB		610.4 GB		611.2 GB		612.0 GB		612.8 GB		613.6 GB		614.4 GB		615.2 GB		616.0 GB		616.8 GB		617.6 GB		618.4 GB		619.2 GB		620.0 GB		620.8 GB		621.6 GB		622.4 GB		623.2 GB		624.0 GB		624.8 GB		625.6 GB		626.4 GB		627.2 GB		628.0 GB		628.8 GB		629.6 GB		630.4 GB		631.2 GB		632.0 GB		632.8 GB		633.6 GB		634.4 GB		635.2 GB		636.0 GB		636.8 GB		637.6 GB		638.4 GB		639.2 GB		640.0 GB		640.8 GB		641.6 GB		642.4 GB		643.2 GB		644.0 GB		644.8 GB		645.6 GB		646.4 GB		647.2 GB		648.0 GB		648.8 GB		649.6 GB		650.4 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DATABASES

Adding an "All Others" Line to Grouped Reports



You've probably run into this situation: You give a customer a huge report that lists all rows by group, with group totals. Immediately, the customer notices that many of the rows have nonessential values and that these rows clutter the reports. The customer asks for a report that shows only the rows that make up 90 percent of the group's total, with the rest rolled up into an "all others" line.

This is easy to accomplish using Microsoft Access—you just need to add a few invisible controls and some minor code to the report. Let's assume you're grouping Product Sales By Company. Each group starts with a header identifying the company, followed by a detail section showing each product's sales. The Company footer contains a [Total_Product Sales] control showing the total sales to that company.

To change this report to use an "all others" line in each group, first place an unbound control in the Company group header, name it `grpOtherSum`, and make it not visible. This control will hold the calculated "all other" sales amount. Then place the following code in the Company group header's On Format event to initialize the control for each group:

```
[grpOtherSum] = 0
```

Now, in the detail section of the report, place two unbound controls, one for a group running the sum of Product Sales, named `grpRunningSum`, and the other to calculate the running sum's percentage of the group's total sales, named `grpPercentOfTotal`. For `grpRunningSum`, set the control source equal to [Product Sales], the column we're summing up. Next, set the "Running Sum" property to "Over Group" and make the control not visible.

Then, set the `grpPercentOfTotal`'s control source equal to:

```
[grpRunningSum] /  
= [Total_Product Sales]
```

Format the cell to be a percent. Then, in the detail section of the report, place the following code in the On Print event:

```
If [grpPercentOfTotal] > .9 Then  
  [grpOtherSum] = [grpOtherSum] +  
    [Product Sales]  
  Me.MoveLayout = False  
  Me.NextRecord = True  
  Me.PrintSection = False  
End If
```

This code, executed for every detail row in the group, checks to see if the [grpPercentOfTotal] control is greater than 90 percent. If it is, the code adds the current row's [Product Sales] to the "all others" sum. When used in combination, the MoveLayout, NextRecord, and PrintSection report section properties have the effect of turning off the printing for the remaining records in the group.

Finally, add an unbound control to the Company group footer and set its control source equal to [grpOtherSum]. This provides the "all others" sales amount. Don't forget to add an "all others" label.

DAVE LINDSTROM

Cranston, Rhode Island

PC MAGAZINE: This is a neat technique that can cut down a voluminous report to manageable size. Figure 3 shows a sample report page with an "all others" line implemented.

If you're new to Access, it may not be obvious that you can use a value computed in the group footer earlier in the report, in the detail band. Access, in effect, computes the group's [Total_Product Sales] first so you can then use that value in calculations in the detail section, such as when computing a percentage of total sales, as is done here.

Understanding the MoveLayout, NextRecord, and PrintSection report section properties is key to understanding Mr. Lindstrom's technique. Access sets these properties to True just before processing the On Format event for the current section. Thus, in the detail section, Access sets these properties to True prior to processing the On Format event for the current detail row. The On Format event occurs before the On Print event, so when your On Print code gets control, all of the properties will have been set to True (provided you didn't change them in the On Format event code).

The MoveLayout setting determines whether the report should move to the next print location. Setting it to False keeps the print position exactly where it is. Thus, once the total's percentage reaches 90, setting MoveLayout to False prevents any further movement of the print position.

The NextRecord setting determines whether the next row is retrieved from the record source. Setting it to True allows the next row to be processed. Thus, once the total's percentage reaches 90, setting NextRecord to True permits Access to get the next row, even though the print position doesn't change.

Finally, the PrintSection setting determines whether the current section will be printed. Setting it to False prevents printing. Thus,

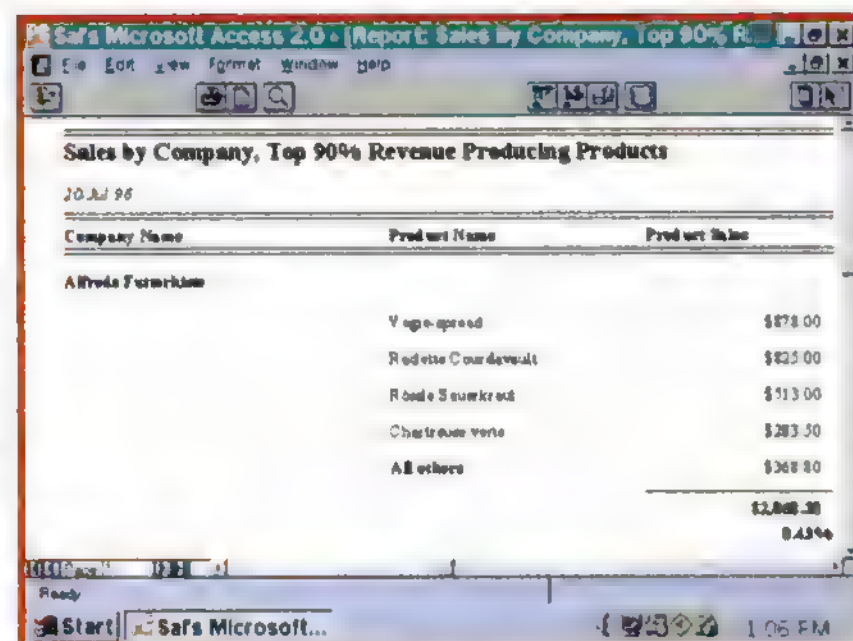


FIGURE 3: Using the technique described in the text, you can create reports that accumulate results into an "all others" line, as the report shown here does.

the combination of MoveLayout=False, NextRecord=True, PrintSection=False doesn't print anything but does process rows, which is the behavior we want so we can accumulate the "all others" sum for printing in the group footer.

You'll find a number of potential uses for setting these values different ways. For instance, setting both MoveLayout and PrintSection to True and NextRecord to False lets you move to the next report section and print additional information from the current row—useful when everything you need doesn't fit into one section.

Don't forget to sort the report data appropriately when using this technique. For example, the data in the example is sorted in descending order by Product Sales, so that those products that make up the top 90 percent come before those whose sales are less meaningful, which are therefore combined into "all others." If the sort order were not descending, the report would be incorrect. —Sal Ricciardi

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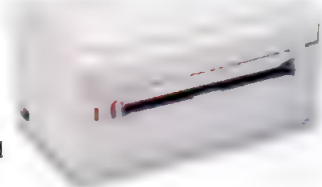
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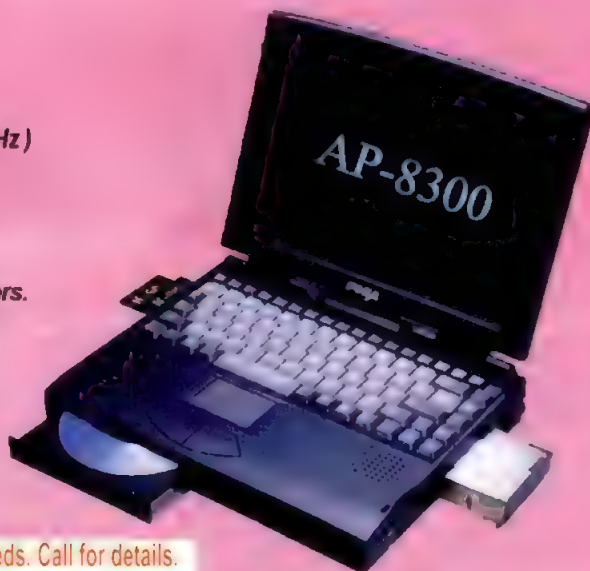
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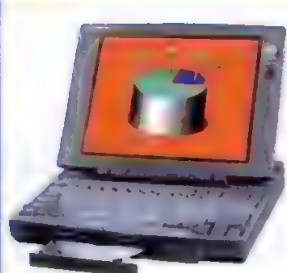
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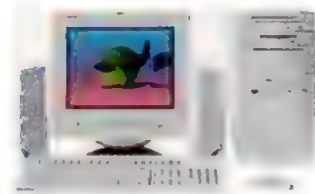
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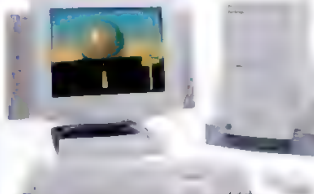
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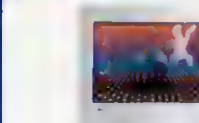
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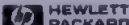
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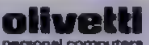
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Tecra 720

Tecra 720

- Pentium 133MHz processor
- Built-in 28.8 fax modem
- Built-in 6X CD-ROM drive
- Optional Desktop capabilities

Model	Processor	Screen	RAM/HD	Price
720	Pentium 133	12.1" Active	16MB/1.1GB	\$5399

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NEW PENTIUM 150 MHz



Tecra 730

Tecra 730

- Pentium 150MHz processor
- 6X CD-ROM drive and audio
- Built-in 28.8 fax modem with speakerphone
- 1280 x 1024 external resolution

Model	Processor	Screen	RAM/HD	Price
730	Pentium 150	12.1" Active	16MB/2GB	\$6099

Satellite 110

- Pentium 100MHz processor
- 11.3" Dual Scan and Active Matrix displays
- Built-in AC adapter
- Fast system performance with EDO RAM memory

Model	Processor	Screen	RAM/HD	Price
110CS	Pentium 100	11.3" Dual Scan	8/772MB	\$1999
110CT	Pentium 100	11.3" Active	8/772MB	2499

Satellite Pro 420



Satellite Pro 420

- Pentium 100MHz processor
- Built-in 6X CD-ROM drive
- 11.3" Dual Scan & Active Matrix displays
- Built-in SoundBlaster Pro compatible audio

Model	Processor	Screen	RAM/HD	Price
420CDS	Pentium 100	11.3" Dual Scan	8/772MB	\$2499
420CDT	Pentium 100	11.3" Active	8MB/1.2GB	3299

Portégé 650

- 133MHz processor
- Built-in 28.8 fax modem
- Built-in SoundBlaster compatible audio
- Up to 11.3" Active Matrix display



Portégé 650

Model	Processor	Screen	RAM/HD	Price
650CT	Pentium 133	11.3" Active	16MB/1.2GB	\$4499

Tecra 500

- Pentium 120MHz processor
- Built-in 6X CD-ROM drive on 500CPT optional accessory on Tecra 500CS
- 16MB EDO RAM memory
- 12.1" Super VGA displays



Tecra 500

Model	Processor	Screen	RAM/HD	Price
500CS	Pentium 120	12.1" Dual Scan	16MB/1.3GB	\$3699
500CDT	Pentium 120	12.1" Active	16MB/1.3GB	4699

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Montego Notebook

- 4.9 lb weight
- EDO RAM memory
- Built-in 16-bit SoundBlaster compatible audio
- 100MHz Pentium processor
- 28.8 PCMCIA fax modem



Montego Notebook

Model	Processor	Screen	RAM/HD	Price
Montego	Pentium 100	10.4" Active	8MB/1GB	\$2999

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Milan Notebook

- Up to 133MHz Pentium processors
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- Built-in 16-bit SoundBlaster audio
- Only 1" thick and 5.9 lbs



Milan Notebook

Model	Processor	Screen	RAM/HD	Price
Milan	Pentium 100	10.4" Dual Scan	8/810MB	\$1799
Milan	Pentium 100	10.4" Active	8/810MB	2499
Milan	Pentium 120	11.3" Active	8MB/1.2GB	3199
Milan	Pentium 120	11.3" Active	8MB/1.2GB	3349
Milan	Pentium 133	11.3" Active	16MB/1.2GB	3699
Milan	Pentium 133	11.3" Active	16MB/1.2GB	3849

* Features 28.8 PCMCIA fax/modem

Monte Carlo Notebook

- Up to 133MHz Pentium processors
- Built-in 6X CD-ROM drive
- 2MB video memory
- 16MB RAM memory on selected models



Monte Carlo Notebook

Model	Processor	Screen	RAM/HD	Price
Monte Carlo	Pentium 100	11.3" Active	8/810MB	\$2999
Monte Carlo	Pentium 100	11.3" Active	8/810MB	3149
Monte Carlo	Pentium 120	11.3" Active	16MB/1GB	3699
Monte Carlo	Pentium 120	11.3" Active	16MB/1GB	3849
Monte Carlo	Pentium 133	12.1" Active	16MB/1GB	4499
Monte Carlo	Pentium 133	12.1" Active	16MB/1GB	4649

* Features 28.8 PCMCIA fax/modem

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- 10.4" & 11.3" SVGA displays
- 16-bit sound, speakers and microphone
- Infrared port for wireless communications
- External floppy drive on 365XD

ThinkPad® 365X/XD

Model	Processor	Screen	RAM/HD	Price
365X	Pentium 133	11.3" Dual Scan	8MB/1GB	\$2499
365X	Pentium 120	10.4" Active	8/810MB	2499
365XD	Pentium 120	10.4" Active	8/810MB	2799
365XD	Pentium 133	11.3" Active	8MB/1.4GB	3499

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- EDO RAM memory enhances performance
- Infrared transceiver for wireless communication

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ThinkPad® 560

Model	Processor	Screen	RAM/HD	Price
560	Pentium 100	11.3" Dual Scan	8/810MB	\$2699
560	Pentium 120	12.1" Active	8/810MB	3749
560	Pentium 133	12.1" Active	8MB/1.1GB	4199

COMPAQ

Compaq Armada



Armada

Model	Processor	Screen	RAM/HD	Price
1120	Pentium 100	10.4" Dual Scan	8/810MB	\$1879
1120T	Pentium 100	10.4" Active	8/810MB	2199
4110	Pentium 100	11.3" Dual Scan	8/810MB	2479*
4110D	Pentium 100	11.3" Dual Scan	8/810MB	2899*
4120	Pentium 120	11.3" Dual Scan	16MB/1.1GB	2999*
4120T	Pentium 120	11.8" Active	16/810MB	3699*
4130T	Pentium 133	11.8" Active	16MB/1.1GB	4399*

* Features built-in audio
† Includes 4X CD-ROM drive

LTE 5000 Series

Model	Processor	Screen	RAM/HD	Price
5150	Pentium 100	11.3" Dual Scan	8/810MB	\$2849
5250	Pentium 120	10.4" Active	16/810MB	3599
5280	Pentium 120	11.3" Active	16MB/1.35GB	4349
5200	Pentium 120	10.4" Active	8MB/1.35GB	4720
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LTE 5000 Series



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NEC Versa 6000

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- Built-in 6X CD-ROM drive
- 2MB video memory
- Built-in 28.8 cellular fax modem

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Model	Processor	Screen	RAM/HD	Price
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6030H	Pentium 133	12.1" Active	16MB/1.3GB	4999
6030X	Pentium 133	12.1" Active	16MB/1.4GB	5399

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NEC Versa 6000



NEC Versa 4200

NEC Versa 4200

- Pentium 100 and 133MHz processors
- SoundBlaster Pro compatible audio with 2 speakers
- With VersaBay II for optional 2nd battery or CD-ROM
- Full-screen MPEG video, 4 audio ports and mic

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Model	Processor	Screen	RAM/HD	Price
4200	Pentium 100	10.4" Active	8/810MB	\$2999
4230	Pentium 133	10.4" Active	8MB/1.0GB	3899

TEXAS INSTRUMENTS



Extensa 570

Extensa 510/570

- 100MHz Pentium processor
- Built-in 6X CD-ROM drive on 570 models only
- Windows for Workgroups or Windows 95
- Built-in 16-bit audio, speaker and microphone

Model	Processor	Screen	RAM/HD	Price
510	Pentium 100	10.4" Dual Scan	8/810MB	\$1749
570CD	Pentium 100	11.3" Dual Scan	8/810MB	2249
570CDT	Pentium 100	10.4" Active	8MB/1.2GB	2939
570CDT	Pentium 100	10.4" Active	8MB/2.0GB	3429

TravelMate 6000

- Up to 150MHz Pentium processors!
- Up to 12.1" Super VGA Active Matrix displays
- PCMCIA 28.8 fax/modem
- 2MB video memory

150 MHz Pentium!

Model	Processor	Screen	RAM/HD	Price
6020	Pentium 120	11.3" Active	8MB/1.08GB	\$4099
6030	Pentium 133	12.1" Active	16MB/1.35GB	4889
6050	Pentium 150	12.1" Active	16MB/1.35GB	5379

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Hitachi E™ Series

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- Only 1.6" thick and 5.8 lbs

Model	Processor	Screen	RAM/HD	Price
E100D	Pentium 100	11.3" Dual Scan	8/810MB	\$1999
E100T	Pentium 133	11.3" Active	16/810MB	2999

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- Integrated 10 Base T Ethernet card
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M100D	Pentium 100	11.3" Dual Scan	8/810MB	2299
M120T	Pentium 120	11.8" Active	16MB/1GB	4499
M120T	Pentium 120	11.8" Active	16MB/1GB	4499
M133T	Pentium 133	11.8" Active	16MB/1GB	4999
M133T	Pentium 133	11.8" Active	16MB/1GB	4999

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9020	Pentium 120	12.1" Dual Scan	16MB/1.1GB	2899†
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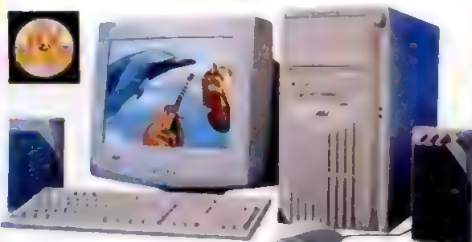


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9622	Pentium 166	16MB/2.5GB	8X	2199
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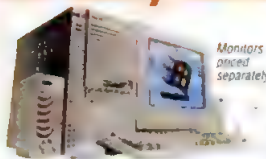
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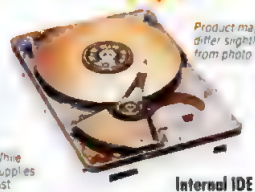
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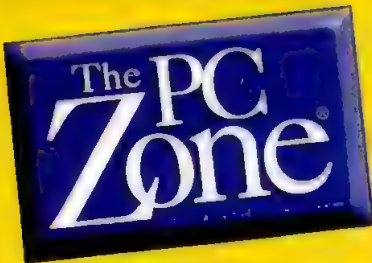
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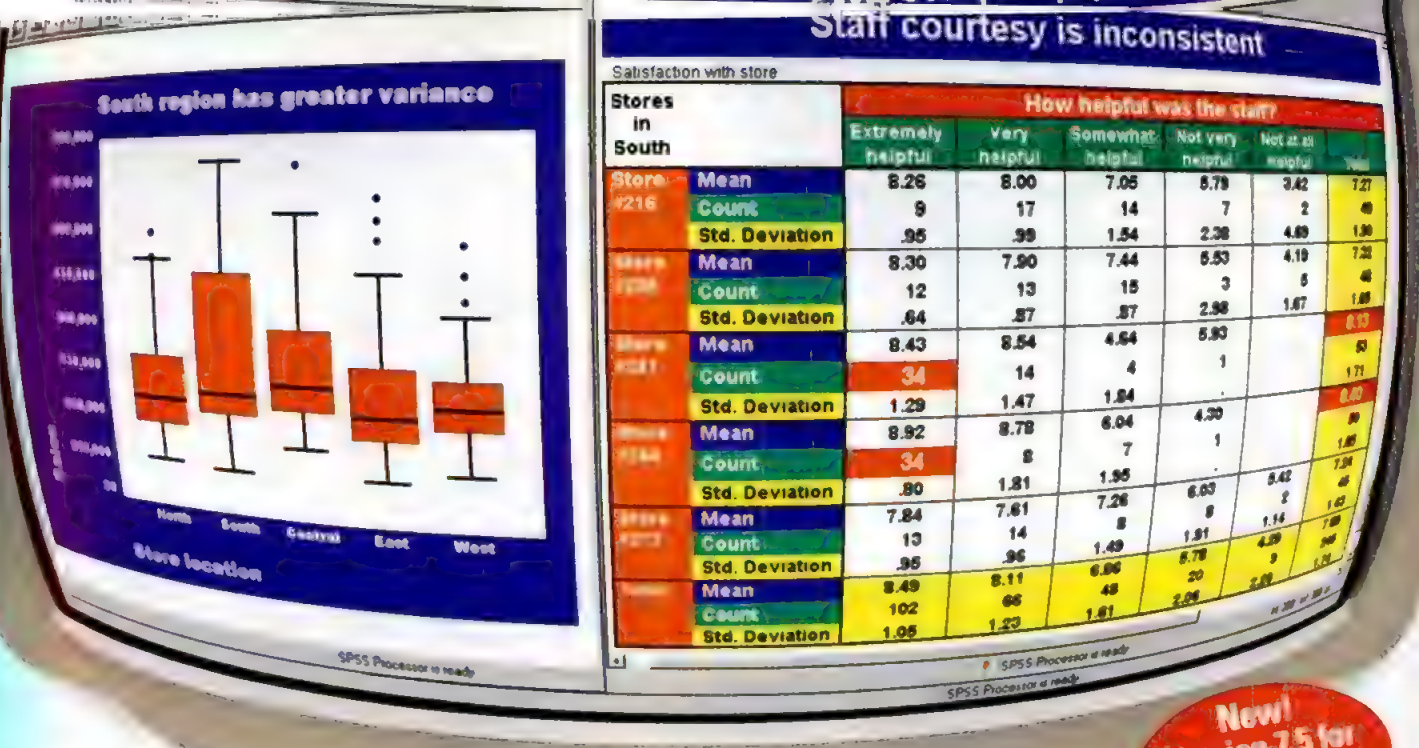
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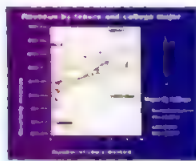
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Quantum

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#TM33200A
\$329

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IDE Hard Drive
#ST31621A
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FUJITSU

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#M1638T
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Converts any 3 1/2" hard drive into a removable drive. Great for transportability, data interchange, or security needs. Extremely high quality construction. Metal cartridge and frame, cooling fan. Unit has SCSI ID select on the cartridge. Qty discounts available.

	System	Extra Cartridge	Extra Frame
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SCSI	\$85	\$40	\$54
WIDE SCSI	\$129	\$64	\$75

Weather resistant case to store and transport cartridge \$35

HOT SOLUTION

PIONEER

10X
CD ROM

IDE \$169
SCSI \$199

Zip

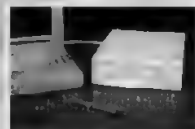
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Drives include 1 FREE cartridge.

100MB Zip	\$189
1Gig Jaz int	\$379
1Gig Jaz ext	\$439

Smart Storage Solutions Parallel Drives



Simple to install - you don't even have to open your computer's case. Just plug the drive into your PC's parallel printer port and your printer into the back of the drive. You can use your printer and your drive without switching any cabling.

Hard Drives

1 Gig	\$319
1.6 Gig	\$415
2 Gig	\$479
2.5 Gig	\$525
3 Gig	\$599

CD ROM Drives

4X	\$179
6X	\$199
8X	\$249
10X	\$459

Smart Storage Solutions CD Towers



Allows access to multiple CDs at one time. Perfect for schools, BBS, etc. Budget Towers feature a 200w power supply, Epic Towers feature dual 65w power supplies. Listed are 4/7 drive towers - 2 to 21 drive towers are available.



NEC	4X	Budget \$659/\$1149	Epic \$759/\$1259
Plextor	6X	Budget \$1599/\$2789	Epic \$1699/\$2899
Philips	8X	Budget \$1359/\$2389	Epic \$1459/\$2499
Pioneer	10X	Budget \$1399/\$2389	Epic \$1499/\$2499

Smart Storage Solutions CR Recorders

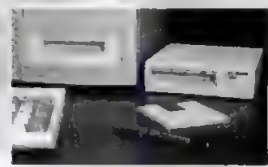


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4x4 Mac External	\$999

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Internal & External drives include formatting software, Kits include ASPI compliant SCSI controller. All come with 1 free disk and toll free technical support!



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230MB	\$339	\$399	\$399	\$459	\$449
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A1505CDKIT, ISA, PIO, non bootable, 5MB/s	\$60
A1515KIT, ISA, PIO, 5MB/s	\$97
A1522KIT, ISA, Floppy, PIO, 10MB/s	\$149
A1542C, Bare, ISA, Floppy, Bus Master	\$210
A1542CKIT, ISA, Floppy, Bus Master	\$249
A2920KIT, PCI, PIO	\$159
A2940, Bare, PCI, Bus Master	\$199
A2940KIT, PCI, Bus Master	\$259
A2940WKIT, PCI, Wide SCSI, Bus Master	\$299
A2940MUW, PCI, Wide SCSI, for Macintosh	\$325
A3940KIT, PCI, Twin Channel, Bus Master	\$419
A3940WKIT, PCI, Wide, Twin Channel, Bus Master	\$519
A3985KIT, PCI, RAID, Bus Master	\$719
A3985WKIT, PCI, Wide, RAID, Bus Master	\$819
A2842VLKIT, VESA, Floppy, Bus Master	\$239
A2825VLKIT, EIDE, SCSI, floppy	\$135

MEDIA

TAPE		1-4	5-9	10-29
TR1	[TR1]	\$32	\$27	\$25
TR3	[TR3]	\$34	\$29	\$27
TR4	[TR4]	\$41	\$36	\$34
QW3010	[QW3010]	\$30	\$25	\$23
QW3020	[QW3020]	\$30	\$25	\$23
QW3080	[QW3080]	\$32	\$27	\$25
4mm 90M	[DAT90M]	\$15	\$10	\$8
4mm 120M	[DAT120M]	\$27	\$22	\$20
8mm 112M	[DAT112M8MM]	\$15	\$10	\$8

OPTICAL DISKS				
230MB	[TJ230]	\$20	\$16	\$14
650MB 1024K	[TJ650]	\$45	\$41	\$39
1.3GB 1024K	[TJ1.3]	\$51	\$47	\$45
2.6GB 1024K	[TJ2.6]	\$69	\$65	\$63

SYQUEST				
88MB	[SQ800]	\$48	\$44	\$42
135MB	[EZDISK]	\$26	\$22	\$20
200MB	[SQ2000]	\$72	\$68	\$66
230MB	[EZ230C]	\$30	\$26	\$24
270MB	[SQ327]	\$58	\$54	\$52

NOMAI (SyQuest compatible)				
44MB	[N450U]	\$34	\$30	\$28
88MB	[N900U]	\$38	\$34	\$32
200MB	[N200U]	\$62	\$58	\$56
270MB	[N270U]	\$52	\$48	\$46

IOMEGA				
100MB ZIP	[ZIP100C]	\$23	\$18	\$16
1Gig JAZ	[JAZC-1GIG]	\$99	\$95	\$93

OPTICALS

All Optical Drive prices below include 1 FREE cartridge.

230MB	Fujitsu IDE	\$339
230MB	Smart Storage Solutions SCSI	\$339
640MB	Smart Storage Solutions SCSI	\$539
640MB	Fujitsu (230MB backwards compatible)	\$555
650MB	PD ROM combination optical & 4XCD	\$469
1.3Gig	Maxoptix	\$1039
2.6Gig	Smart Storage Solutions	\$1649
2.6Gig	Maxoptix	\$1789
2.6Gig	Hewlett Packard	\$2219
52Gig	Maxoptix (does not include free disks)	\$4549

REMOVABLES

540MB MCD		
Backwards compatible with SyQuest 270MB media. SCSI		
SYQUEST		
230MB Flyer compatible with EZ135MB disks		
External SCSI or parallel with 1 free disk		\$299
200MB compatible with 44 and 88MB disks		
Internal SCSI/External SCSI		\$269/\$339
1.3Gig 1 free disk Internal SCSI/External SCSI		\$399/\$499

CD RECORDERS

BARE DRIVES

Yamaha	2X Write 4X Read	\$550
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Smart Storage Solutions	2X Write 4X Read	\$619
HP Ask about \$200 Rebate	2X Write 4X Read	\$829
Smart & Friendly	2X Write 4X Read	\$799
Smart Storage Solutions	4X Write 4X Read	\$925

CD ROM DRIVES

SCSI

Brand	Spin	Model	Speed	Int	Ext
NEC	4X	CDR222	200ms	\$99	\$189
Plextor	4.5X	PX43CE	130ms	\$230	\$320
Plextor	6X	PX63CS	145ms	\$269	\$359
Philips	8X	PC80S	195ms	\$225	\$315
NEC	8X	CDR1410	145ms	\$219	\$309
Plextor	8X	PX83CS	115ms	\$339	\$429
Pioneer	10X	DRA10X	140ms	\$239	\$329
ATAPI IDE				Int	Ext
NEC	6X	CDR1300	145ms	\$79	\$94
Acer	8X	AC885A	190ms	\$99	\$114
Mitsumi	8X	CMCFX800	150ms	\$120	\$135
Teac	8X	CD58E	110ms	\$115	\$130
Toshiba	8X	XM5602B	145ms	\$115	\$130
NEC	8X	CDR1400	140ms	\$150	\$165
Pioneer	10X	DRA10X	140ms	\$199	\$214

IDE CD ROM CHANGER

NEC	4X	CDR4X4	4Disk	250ms	\$99
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SCSI CD ROM CHANGERS

Nakamichi	8X	MJ48S	4Disk	150ms	\$549
Pioneer	4.4X	DRM-624X	6 Disk	190ms	\$359

TAPE DRIVES

QIC MINICARTRIDGE (SAVE \$10 with hard drive purchase)
Includes DOS/Win backup software and 1 free tape.

800MB	Seagate	TST800R	\$141
1Gig	Seagate	TST800PLUS	\$159
1.7Gig	Seagate	TSM1700	\$219
3.2Gig	Seagate	TST3200RFT	\$245

PRINTER PORT MINICARTRIDGE

Includes DOS/Win backup software and 1 free tape.

800MB	Seagate	TST800RPT	\$259
1Gig	Seagate	TST800PLUS	\$269

IDE TRAVAN

(SAVE \$10 with hard drive purchase)
Includes DOS/Win backup software and 1 free tape.

4-8GB	Seagate	TST8000A	\$385
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SCSI TRAVAN

(SAVE \$10 with hard drive purchase)
Includes DOS/Win backup software and 1 free tape.

4-8GB	Seagate	TST8000	\$385
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SCSI 4mm DAT

2GB	Hewlett Packard	C1534	\$609
2-4GB	Seagate	C4324RP	\$679
2-4GB	Hewlett Packard	C1536	\$699
4-8GB	Sony	SDT5000	\$809
4-8GB	Seagate	C4326NP (DDS2)	\$859
4-8GB	Hewlett Packard	C1533A	\$929

4-8GB Sony

TURBO SPEED 46MB/sec uncompressed or 90MB/sec with onboard compression

24-48GB	HP	External 6 tape loader C1553AX	\$2299
32-64GB	Sony	TSL7000 8 tape autoloader	\$2199
48-96GB	Seagate	C4586NP 12 tape autoloader	\$2399

SCSI 8mm DAT

3.5-7GB	Exabyte	EXB8205XL	\$1269
7-14GB	Exabyte	EXB8505XL	\$1889
7-14GB	Exabyte	EXB8700LT	\$1149
20-40GB	Exabyte	EXB8900	\$5499
70-140GB	Exabyte	EXB10H 10 tape autoloader	\$5439

SCSI DLT

15-30GB	Quantum	DLT2000	\$2499
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BACKUP SOFTWARE

NovaStor's NovaBack CD contains software for DOS, Win 3.1, Win 95, OS/2, Warp, and Macintosh	\$79
Seagate Arcadia for Windows NT (call for network version) workstation/single server/enterprise	\$239/499/869
TAPEDISK, allows DAT drive to be used as hard drive under DOS/Win 3.1, Win 95	\$189

IDE HARD DRIVES

IDE	Speed	RPM	Brand	Model	Wty	Price
540MB	14ms	3600	Seagate	ST3541A	3	\$151
540MB	14ms	4480	Maxtor	M7541A	3	\$159
850MB	10ms	4500	Western Digital	AC2850	3	\$165
850MB	14ms	3600	Seagate	ST3851A	3	\$171
1002MB	11ms	4480	Maxtor	M71000A	3	\$179
1084MB	14ms	4480	Maxtor	M71084A	2	\$185
1090MB	11ms	4500	Fujitsu	M1614T	3	\$165
1200MB	10ms	5400	Fujitsu	M1636T	3	\$199
1250MB	15ms	3600	Quantum	BF1250A	3	\$175
1270MB	10.5ms	5400	Seagate	ST51270A	3	\$187
1280MB	12ms	5400	Quantum	FB1280A	3	\$198
1281MB	11ms	5200	Western Digital	AC21200A	3	\$192
1336MB	11ms	4480	Maxtor	M71336A	3	\$190
1620MB	14ms	3600	Seagate	ST31621A	3	\$207
1624MB	10ms	5200	Western Digital	AC31600	3	\$225
1626MB	11ms	4480	Maxtor	M71626AP	3	\$220
1700MB	10ms	5400	Fujitsu	M1623T	3	\$219
1700MB	11ms	4500	Quantum	SR31700A	3	\$218
2004MB	11ms	4480	Maxtor	M72004A	3	\$265
2100MB	11ms	5200	Western Digital	AC32100	3	\$285
2100MB	9ms	5400	Fujitsu	M1624T	3	\$275
2167MB	10.5ms	5400	Seagate	ST32160A	3	\$262
2168MB	10.5ms	4500	Quantum	TM32160A	3	\$270
2500MB	9ms	5400	Fujitsu	M1638T	3	\$289
2550MB	15ms	3600	Quantum	BF2500A	3	\$259
2550MB	11ms	4500	Quantum	SR32550A	3	\$299
2559MB	11ms	5200	Western Digital	AC32500	3	\$319
3166MB	12ms	5200	Western Digital	AC33100	3	\$409
3254MB	10.5ms	4500	Quantum	TM33200A	3	\$329
4250MB	10.5ms	5400	Seagate	ST34250A	3	\$Call

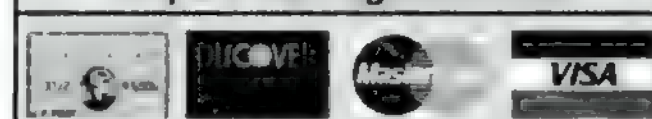
SCSI HARD DRIVES

SCSI	Speed	RPM	Brand	Model	Wty	Int	Ext
1050MB	9ms	5400	Seagate	ST31055N	3	\$339	\$399
1080MB	12.5ms	5400	Seagate	ST31080N	3	\$259	\$319
1082MB	12ms	4500	Quantum	TM31080S	3	\$299	\$359
2147MB	9ms	5400	Seagate	ST32155N	5	\$499	\$559
2147MB	8ms	7200	Seagate	ST32550N	5	\$729	\$789
2150MB	8.5ms	7200	Quantum	XP32150	5	\$639	\$699
2168MB	10.5ms	4500	Quantum	TM32160S	3	\$425	\$485
3254MB	10.5ms	4500	Quantum	TM33200S	3	\$329	\$389
4290MB	8ms	7200	Seagate	ST15230N	5	\$889	\$949
4290MB	8ms	7200	Seagate	ST15150N	5	\$Call	\$Call
4300MB	8.6ms	7200	Quantum	XP34300	5	\$900	\$960
9080MB	11ms	5400	Seagate	ST410800N	5	\$1749	\$1849
WIDE SCSI							
1070MB	8ms	7200	Quantum	XP31070W	5	\$299	\$429
2147MB	8ms	7200	Seagate	ST32550W	5	\$789	\$919
2150MB	9ms	5400	Seagate	ST32155W	5	\$559	\$689
2150MB	8.5ms	7200	Quantum	XP32150W	5	\$649	\$779
4294MB	8ms	7200	Seagate	ST15150W	5	\$Call	\$Call
4300MB	8.6ms	7200	Quantum	XP34300W	5	\$919	\$1049
9100MB	11ms	5400	Seagate	ST410800W	5	\$2029	\$2219
WIDE DIFFERENTIAL SCSI							
4290MB	8ms	7200	Seagate	ST15150WD	5	\$1279	\$1409
4294MB	8ms	7200	Micropolis	MC3243WD	5	\$899	\$1029
9091MB	8.5ms	7200	Micropolis	MC3391WD	5	\$1899	\$2029
9100MB	11ms	5400	Seagate	ST410800WD	5	\$2129	\$2319

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MegaHaus stocks a wide variety of hardware and software RAID solutions from top manufacturers; Adaptec, DPT, Raidtec, Stream Logic (formerly Micropolis Radion), Remus, and Tekram. Call for a quote on products or custom configurations.

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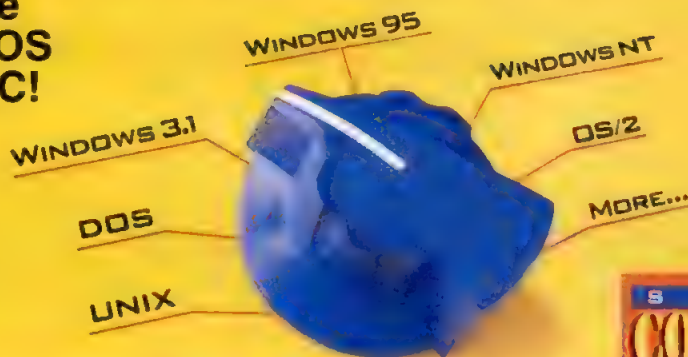
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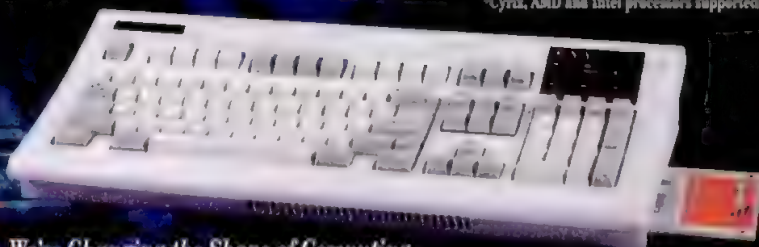
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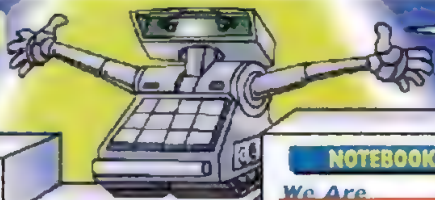
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ST32400N - 2.1G, FSCSI, 9ms	\$529

Western Digital

Caviar AC21000 - 1.08G, FATA, 10ms	\$185
Caviar AC31200 - 1.2G, FATA, 10ms	\$209
Caviar AC31600 - 1.6G, FATA, 10ms	\$225
Caviar 2100RTL - 2.1G, FATA, 12ms	\$305
Caviar 2500RTL - 2.5G, FATA, 12ms	\$339

Quantum

Trailblazer - 850mg, FATA, 14ms	\$189
Fireball - 1.2G, FATA, 12ms	\$219
Sirocco - 1.7G, FATA, 12ms	\$269
Sirocco - 2.6G, FATA, 12ms	\$375

Maxtor

71336A - 1.3G, FATA, 12ms	\$189
71626A - 1.6G, FATA, 12ms	\$219
72004A - 2.1G, FATA, 12ms	\$285

HIGH PERFORMANCE HD

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Atlas - 4.3G, FSCSI, 8ms, 7200, 2048k	\$969

Seagate

Barracuda 2 - 2.1G, FSCSI, 7200, 1024k	\$709
Barracuda 2 - 2.1G, FSCSI, 7200, 1024k	\$749
Barracuda 4 - 4.3G, FSCSI, 7200, 1024k	\$1099
Barracuda 4 - 4.3G, FSCSI, 7200, 1024k	\$1199

MONITORS

Sony

Multiscan 15ax Trinitron Display	\$389
Multiscan 15af Trinitron Display	\$459
Multiscan 17af Trinitron Display	\$789
Multiscan 20af Trinitron Display	\$1,649

NEC

MultiSync M500 25 dpi, 1280x1024	\$519
MultiSync M700 25 dpi, 1280x1024	\$849
MultiSync XV15-15"	\$485
MultiSync XV17-17"	\$795
MultiSync XE21 21"	\$1,679

Mag Innovation

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Jaz Drive - 1gm, incl. cartridge	\$489
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T420CDT - P100, 8/10, 6x 11.3" TFT	\$3739
T500CS - P120, 16/1, 2G, 12.1" DS	\$3789
T500CDT - P120, 16/1, 2G, 12.1" TFT	\$4729

Hitachi

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T720CDT - P133, 16/1, 2G, 12.1" TFT	\$6299
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M120T - P120, 16/1, 4G, 4G, 28.8k, 11.8" TFT	\$4849
M133T - P133, 16/1, 4G, 4G, 28.8k, 11.8" TFT	\$5099

IBM

Thinkpad 500 P100, 8/10, 11.3" DS	\$2599
Thinkpad 760D P133, 16/1, 2G, 12.1" TFT	\$6549

Texas Instruments

Extensa 510 P100, 8/10, 10.4" DS	\$1959
Extensa 570CDT P75, 8/10, 4X, 10.4" TFT	\$3359

Compaq

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Armada 4120 P120, 16/1, 08G, 11.3" DS	\$2959

Digital (Hinode)

VP L75 512K - P120, 8/1, 10G, 11.3" TFT	\$2759
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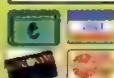
200" video w/ MPEG Striver 2MB	\$125
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64 meg 16/36/32	—	—	—	8Meg		194	
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16-bit (3 chip)	11	11	11	64Meg		1194	
8-bit (3 chip)	12	15	16	128Meg		308	
4-bit (3 chip)	—	26	26	256Meg		919	
2-bit (3 chip)	—	38	38				

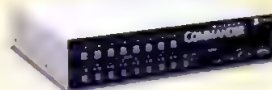
Notebook Memory				EDO Memory			
Module	4MB	8MB	16MB	72 Pin	60ns	70ns	85ns
Acad (all models)	664	114	194	4Meg	41	42	43
AST (most models)	60	114	194	16Meg	88	89	90
AT&T (all models)	60	114	194	32Meg	177	179	
Compaq (all models)	60	114	194	Cache Memory			
Cannon (all models)	64	104	194	8Kb	54	5	6
Dei (all models)	60	104	194	16Kb	6	7	7
DEC (all models)	60	104	194	32Kb (32)	8	9	10
Epson (all models)	60	104	194	64Kb (64)	8	9	10
Figaro (most models)	60	104	194	128Kb	13	13	13
Gateway (most models)	60	104	194	256Kb	19	22	25
Hewlett-Packard (all models)	64	104	194	Video Memory			
IBM (most models)	74	114	194	256Kb	6	7	7
Medwest Micro (all models)	74	114	194	512Kb	6	7	7
NEC (all models)	64	104	194	1MB	13	13	13
Packard Bell (all models)	60	104	194				
Ramsonic (all models)	74	114	194				
Samsung (all models)	60	104	194				
Sharp (all models)	60	104	194				
Texas Instr (most models)	60	104	194				
Toshiba (most models)	64	104	194				
Winbook (most models)	74	114	194				
Zenith (all models)	74	114	194				
Zinc (all models)	74	114	194				

Printer Memory				Printer Memory			
Model	2MB	4MB	8MB	Model	2MB	4MB	8MB
Epson AL1000, 1500	104	104	104	HP HP II, HP III	69	125	—
HP HP II, HP III	69	125	—	HP HP IV	69	125	—
HP HP IV	69	125	—	HP HP V	69	125	—
HP HP V	69	125	—	HP HP VI	69	125	—
HP HP VI	69	125	—	HP HP VII	69	125	—
HP HP VII	69	125	—	HP HP VIII	69	125	—
HP HP VIII	69	125	—	HP HP IX	69	125	—
HP HP IX	69	125	—	HP HP X	69	125	—
HP HP X	69	125	—	HP HP XI	69	125	—
HP HP XI	69	125	—	HP HP XII	69	125	—
HP HP XII	69	125	—	HP HP XIII	69	125	—
HP HP XIII	69	125	—	HP HP XIV	69	125	—
HP HP XIV	69	125	—	HP HP XV	69	125	—
HP HP XV	69	125	—	HP HP XVI	69	125	—
HP HP XVI	69	125	—	HP HP XVII	69	125	—
HP HP XVII	69	125	—	HP HP XVIII	69	125	—
HP HP XVIII	69	125	—	HP HP XIX	69	125	—
HP HP XIX	69	125	—	HP HP XX	69	125	—
HP HP XX	69	125	—	HP HP XXI	69	125	—
HP HP XXI	69	125	—	HP HP XXII	69	125	—
HP HP XXII	69	125	—	HP HP XXIII	69	125	—
HP HP XXIII	69	125	—	HP HP XXIV	69	125	—
HP HP XXIV	69	125	—	HP HP XXV	69	125	—
HP HP XXV	69	125	—	HP HP XXVI	69	125	—
HP HP XXVI	69	125	—	HP HP XXVII	69	125	—
HP HP XXVII	69	125	—	HP HP XXVIII	69	125	—
HP HP XXVIII	69	125	—	HP HP XXIX	69	125	—
HP HP XXIX	69	125	—	HP HP XXX	69	125	—
HP HP XXX	69	125	—	HP HP XXXI	69	125	—
HP HP XXXI	69	125	—	HP HP XXXII	69	125	—
HP HP XXXII	69	125	—	HP HP XXXIII	69	125	—
HP HP XXXIII	69	125	—	HP HP XXXIV	69	125	—
HP HP XXXIV	69	125	—	HP HP XXXV	69	125	—
HP HP XXXV	69	125	—	HP HP XXXVI	69	125	—
HP HP XXXVI	69	125	—	HP HP XXXVII	69	125	—
HP HP XXXVII	69	125	—	HP HP XXXVIII	69	125	—
HP HP XXXVIII	69	125	—	HP HP XXXIX	69	125	—
HP HP XXXIX	69	125	—	HP HP XL	69	125	—
HP HP XL	69	125	—	HP HP XLI	69	125	—
HP HP XLI	69	125	—	HP HP XLII	69	125	—
HP HP XLII	69	125	—	HP HP XLIII	69	125	—
HP HP XLIII	69	125	—	HP HP XLIV	69	125	—
HP HP XLIV	69	125	—	HP HP XLV	69	125	—
HP HP XLV	69	125	—	HP HP XLVI	69	125	—
HP HP XLVI	69	125	—	HP HP XLVII	69	125	—
HP HP XLVII	69	125	—	HP HP XLVIII	69	125	—
HP HP XLVIII	69	125	—	HP HP XLIX	69	125	—
HP HP XLIX	69	125	—	HP HP L	69	125	—
HP HP L	69	125	—	HP HP LI	69	125	—
HP HP LI	69	125	—	HP HP LII	69	125	—
HP HP LII	69	125	—	HP HP LIII	69	125	—
HP HP LIII	69	125	—	HP HP LIV	69	125	—
HP HP LIV	69	125	—	HP HP LV	69	125	—
HP HP LV	69	125	—	HP HP LVI	69	125	—
HP HP LVI	69	125	—	HP HP LVII	69	125	—
HP HP LVII	69	125	—	HP HP LVIII	69	125	—
HP HP LVIII	69	125	—	HP HP LIX	69	125	—
HP HP LIX	69	125	—	HP HP LX	69	125	—
HP HP LX	69	125	—	HP HP LXI	69	125	—
HP HP LXI	69	125	—	HP HP LXII	69	125	—
HP HP LXII	69	125	—	HP HP LXIII	69	125	—
HP HP LXIII	69	125	—	HP HP LXIV	69	125	—
HP HP LXIV	69	125	—	HP HP LXV	69	125	—
HP HP LXV	69	125	—	HP HP LXVI	69	125	—
HP HP LXVI	69	125	—	HP HP LXVII	69	125	—
HP HP LXVII	69	125	—	HP HP LXVIII	69	125	—
HP HP LXVIII	69	125	—	HP HP LXIX	69	125	—
HP HP LXIX	69	125	—	HP HP LXX	69	125	—
HP HP LXX	69	125	—	HP HP LXXI	69	125	—
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HP HP LXXXIII	69	125	—	HP HP LXXXIV	69	125	—
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HP HP LXXXVI	69	125	—	HP HP LXXXVII	69	125	—
HP HP LXXXVII	69	125	—	HP HP LXXXVIII	69	125	—
HP HP LXXXVIII	69	125	—	HP HP LXXXIX	69	125	—
HP HP LXXXIX	69	125	—	HP HP LXXXX	69	125	—
HP HP LXXXX	69	125	—	HP HP LXXXXI	69	125	—
HP HP LXXXXI	69	125	—	HP HP LXXXXII	69	125	—
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HP HP LXXXXVII	69	125	—	HP HP LXXXXVIII	69	125	—
HP HP LXXXXVIII	69	125	—	HP HP LXXXXIX	69	125	—
HP HP LXXXXIX	69	125	—	HP HP LXXXXX	69	125	—
HP HP LXXXXX	69	125	—	HP HP LXXXXXI	69	125	—
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HP HP LXXXXXIII	69	125	—	HP HP LXXXXXIV	69	125	—
HP HP LXXXXXIV	69	125	—	HP HP LXXXXXV	69	125	—
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HP HP LXXXXXVII	69	125	—	HP HP LXXXXXVIII	69	125	—
HP HP LXXXXXVIII	69	125	—	HP HP LXXXXXIX	69	125	—
HP HP LXXXXXIX	69	125	—	HP HP LXXXXXX	69	125	—
HP HP LXXXXXX	69	125	—	HP HP LXXXXXXI	69	125	—
HP HP LXXXXXXI	69	125	—	HP HP LXXXXXXII	69	125	—
HP HP LXXXXXXII	69	125	—	HP HP LXXXXXXIII	69	125	—
HP HP LXXXXXXIII	69	125	—	HP HP LXXXXXXIV	69	125	—
HP HP LXXXXXXIV	69	125	—	HP HP LXXXXXXV	69	125	—
HP HP LXXXXXXV	69	125	—	HP HP LXXXXXXVI	69	125	—
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HP HP LXXXXXXVIII	69	125	—	HP HP LXXXXXXIX	69	125	—
HP HP LXXXXXXIX	69	125	—	HP HP LXXXXXXX	69	125	—
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HP HP LXXXXXXXVII	69	125	—	HP HP LXXXXXXXVIII	69	125	—
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HP HP LXXXXXXXIX	69	125	—	HP HP LXXXXXXXX	69	125	—
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HP HP LXXXXXXXV	69	125	—	HP HP LXXXXXXXVI	69	125	—
HP HP LXXXXXXXVI	69	125	—	HP HP LXXXXXXXVII	69	125	—
HP HP LXXXXXXXVII	69	125	—	HP HP LXXXXXXXVIII	69	125	—
HP HP LXXXXXXXVIII	69	125	—	HP HP LXXXXXXXIX	69	125	—
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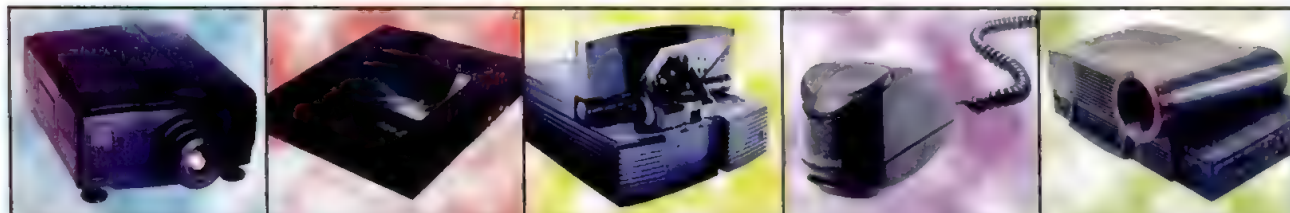
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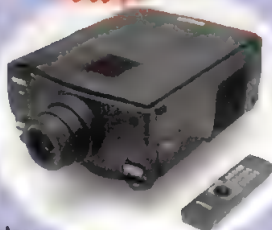
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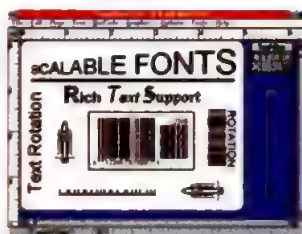
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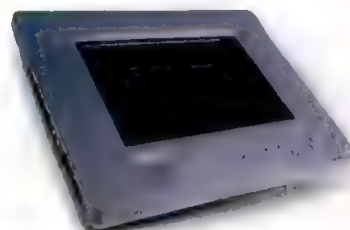
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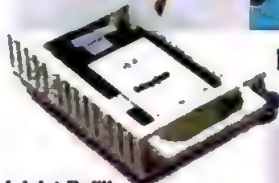
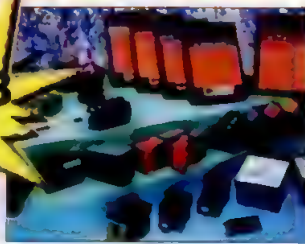
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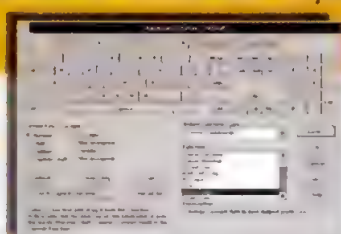
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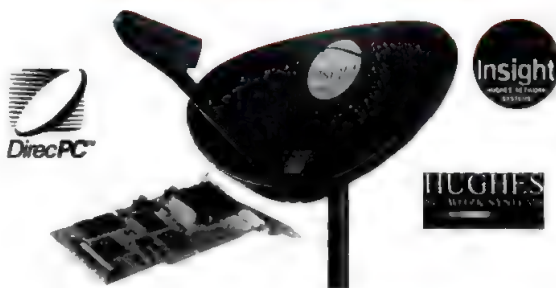
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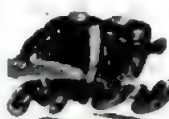
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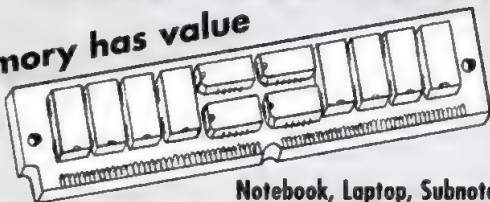
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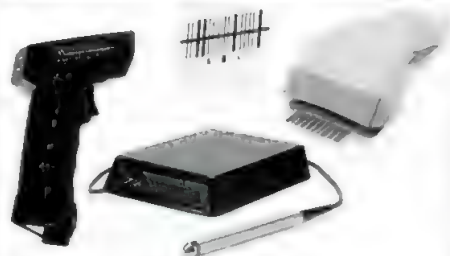
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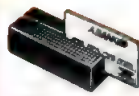
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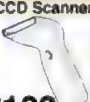
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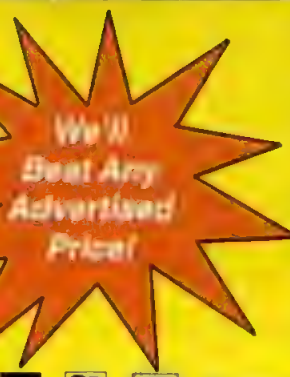
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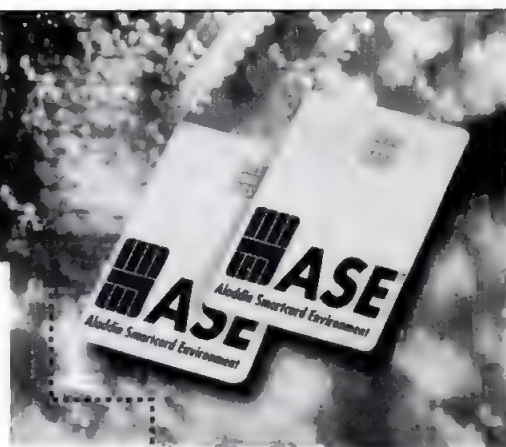
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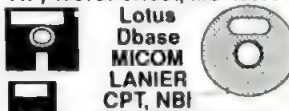
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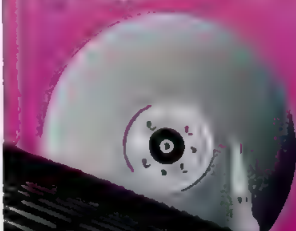
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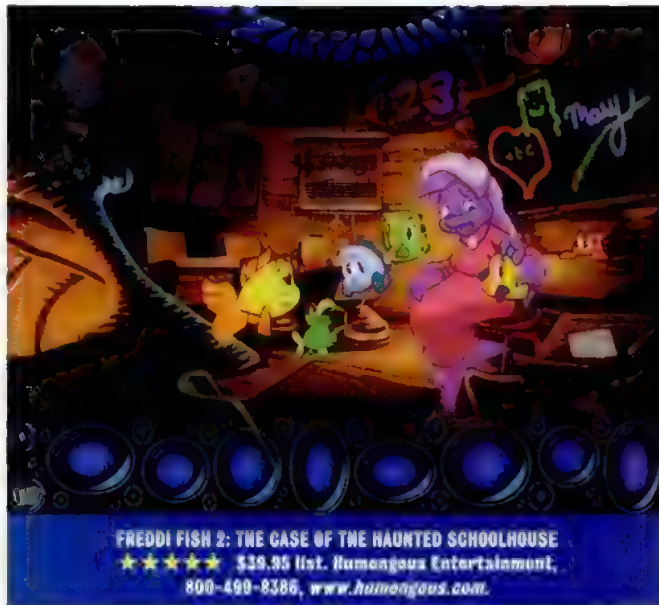


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Freddi Fish 2: The Case of The Haunted Schoolhouse

Freddi's back, and she's got another case to solve. Following up the hit kids' adventure *Freddi Fish* and the *Case of the Missing Kelp Seeds*, Humongous Entertainment brings us *Freddi Fish 2: The Case of the Haunted Schoolhouse*. This cartoon-style adventure game, designed for children ages 3 to 8, has all the color and individualized style of the original, with new characters and 36 new locations to explore. *Freddi Fish 2* runs on Windows 3.x, Windows 95, and Macintosh computers.

As the story begins, *Freddi* learns that a ghost has taken over the schoolhouse and is stealing all the toys. Kids must help *Freddi* and her faithful friend *Luther* as they collect the items necessary to build a surefire ghost trap to rid the schoolhouse of its spooky nemesis. A list of those items is available at the touch of a button, and items you've already found appear in a row of bubbles that runs across the



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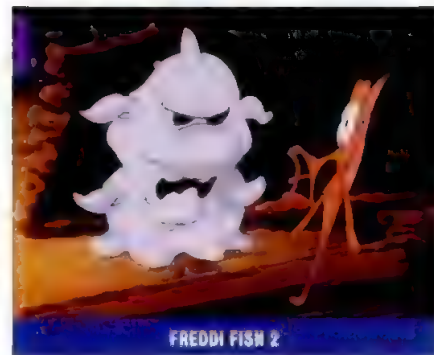
With each new game, the item list changes slightly, making *Freddi Fish 2* a game that kids can play again and again. Although the game requires no reading skills—the entire story is narrated—the item list is written as well as illustrated, encouraging children to associate spoken words and their meanings with written words.

Minigames that kids may stumble across in this click-and-find adventure include *Chalkboard Art*. Here players can scribble on the schoolhouse chalkboard with colored chalk and play with the alphabet and funny sea pictures. Kids can even print their masterpieces to show to friends. And when your children leave the chalkboard and return to *Freddi's* adventure, their most recent works of art appear on the chalkboard in the game.

Moving through *Freddi's* undersea environment, kids can click on hundreds of objects to see animations that

keep the game humorous and lively. Other features of *Freddi's* underwater world include games, Caribbean-style songs, and a host of colorful characters old and new. Kids who loved *Ray the Manta Ray*, *Eddie the Eel*, and *Squidfather* in the original *Freddi Fish* will be equally pleased to meet some of the new faces in *Freddi's* world. *Mrs. Croaker* the schoolteacher, *Barnacle Bob*, and *Tucker Turtle*, who is anything but slow, all play a part in *Freddi Fish 2*.

While there's no doubt that *Freddi Fish 2* offers a lot to young children in terms of fun and educational encouragement, to the adult eye it does have the mild though distinct drawback of being a bit overcrowded. With so many options to choose from, tunnels to search, and games to play, kids will certainly be enthralled. But will they have the patience to see the mystery through to its conclusion? That will depend on what appeals to your child most—the fun and funny animations to explore or the challenge of



solving the mystery.

Either way, *Freddi Fish 2* is a winner that will keep kids entertained and delighted for hours on end.—*Mary Paulson*

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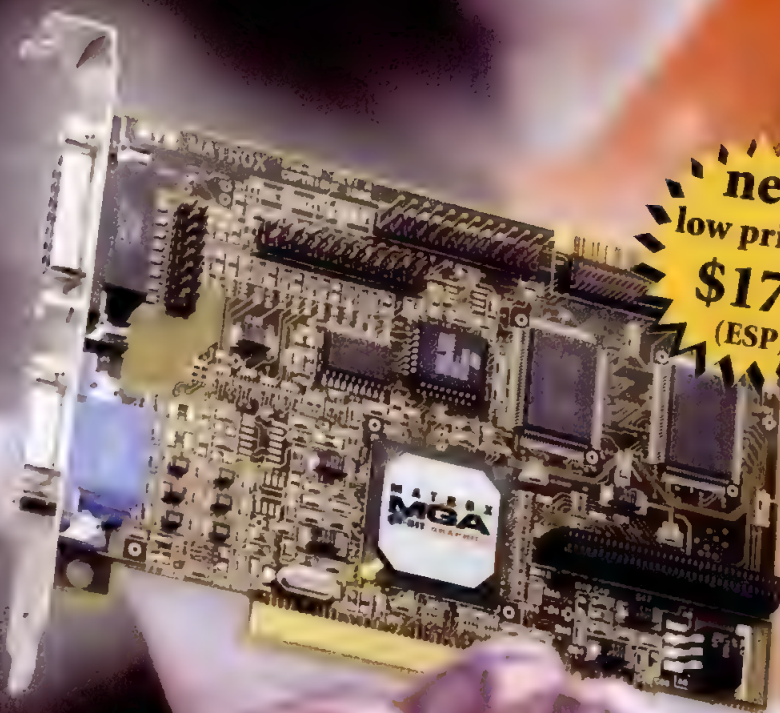
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Colorful Creativity

Got a color ink jet and nothing to do with it? One of these four packages can help.



CreataCard Plus

Most malls have at least one of those do-it-yourself greeting card machines, which come in handy when you want to send a personalized card. Now, with CreataCard Plus, from Micrografx and American Greetings, you can whip up personalized, professional-looking cards on your PC. And unlike mall machines, CreataCard Plus lets you import your own images and fully edit every aspect of the card design.

Every option is explained in simple language in a dialog box, so if you can read, you can make your own cards. The program contains over 3,000 cards predesigned by American Greetings. If you're not happy with these designs, however, you can change everything: the message, the image, even the back page of the card. You can also design invitations, stationery, signs,

awards, and announcements.

Through the American Greetings Web site (www.greetingcard.com), you can download new cards and even send personalized messages over the Internet. CreataCard Plus also comes with a personal reminder program, 50 fonts, and 40 American Greetings screen savers.

A quality program overall, CreataCard Plus provides a simple way to make your own greeting cards and other paper projects.—Richard Brown

Design Shop

Design Shop, from The WizardWorks Group, is a decent printing tool that is well suited for home use. With 69 ready-made templates and over 1,000 clip-art images, you can create the usual banner and calendar fare, as well as coloring books and newsletters.

The less-than-intuitive interface is clearly designed for

adults—or at least kids over 12. The program's graphics are a little too bubbly for professionals, but most home users will probably be able to use the extensive number of design options.

You can take an image and alter its dimensions and color scheme. You can also import images of your own in a variety of formats, though for some reason Design Shop does not support JPEG.

Design Shop should meet most of your creative home printing needs. Unfortunately for WizardWorks, so will less expensive, higher-quality products such as Print Artist 1500 (reviewed later in this section).—RB

Mighty Morphin Power Rangers Print Kit

Any children who consider themselves honorary Power Rangers will love Saban Entertainment's Mighty Morphin Power Rangers Print Kit. The interface is easy to understand, and the program has over 250 images from the TV show and movie. It should keep children busy for hours

creating all manner of Power Rangers paraphernalia—from place mats to posters.

Print Kit opens to the wailing gui-

tar of the Power Rangers theme, and from there a lion-faced sword hilt named Saba directs the action. As you move the cursor from item to item, Saba speaks the name and sometimes provides a brief description of the object you highlight. Children under the age of 7 may need some help navigating this title at first, but older kids should have no trouble at all.

The printouts generated by Print Kit can be pretty plain-looking, usually with just a border, some text, and an image of one symbol or character. So kids who want to orchestrate their own Power Rangers battle scenes might be disappointed. But Mighty Morphin Power Rangers Print Kit provides an excellent forum in which kids can create their own invitations and other projects. Who knows? It could be some young Power Ranger's first step into the world of desktop publishing.—RB



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Also consider Microtek's **ScanMaker® E3** for around \$329 which features 4800 dpi maximum resolution, **ScanWizard**, **Caere's OmniPage Limited Edition** for Windows or Macintosh and either **ULead's PhotoImpact 3.0 SE** and **ImagePals 2Go!** for Windows or **MicroFrontier's Color It!** for Macintosh.

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After Hours

Print Artist 1500

The surprising price attached to Sierra On-Line's Print Artist 1500 helps make this outstanding product even better. For about \$20, you get 1,500 graphics, more than 1,200 lay-



outs, 22 fonts, and output quality that is appropriate for both business and home use.

Print Artist 1500 has a wide variety of templates, whether you need a schedule for an aer-

obics class or a birthday invitation. It also has a unique 3-D craft feature that prints out a cut-and-paste train set, a town (complete with houses, cars, and people), and party favors. All images can be stretched, rotated, and skewed with simple commands.

Adults will like the fact that the images are crisp and slick, and children will like the 3-D. Users of all ages will like the very intuitive interface; even children ages 10 and up should have no problem creating projects on their own.

Print Artist 1500 provides quality production with easy interaction at a low cost. This is a very tough combination to beat in any market.—RB

QUICK CLIPS



Muppet Treasure Island

Based on the movie of the same name, this big-budget, fun-filled children's game spills over with Muppets, puzzles, and adventure. What more could you want? \$49 list; Activision, 800-477-3650.



Robert E. Lee: Civil War General

A detailed and accurate Civil War strategy game played from the Southern perspective, this Sierra title is challenging without being too complex. Nice graphics, too. \$59.95 list; Sierra On-Line Inc., 800-757-7707.



Steel Panthers Campaign Disk

Three new campaigns and 35 standalone missions in Europe and the Pacific make this expansion set a must-have for Steel Panthers fans. \$30 street; Strategic Simulations Inc., 800-601-7529.



Nuke It

Buying this compilation of Duke Nukem add-on user maps may be more convenient than downloading the same content from the Internet, but few of the maps are worth the effort anyway. \$29.99 list; Micro Star Software, 800-444-1343.

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Family Tree Maker™ Deluxe Edition does more than print family trees. It includes an index of more than **100 MILLION** names that helps you find your ancestors. Now, you can create a lasting record of your family history!

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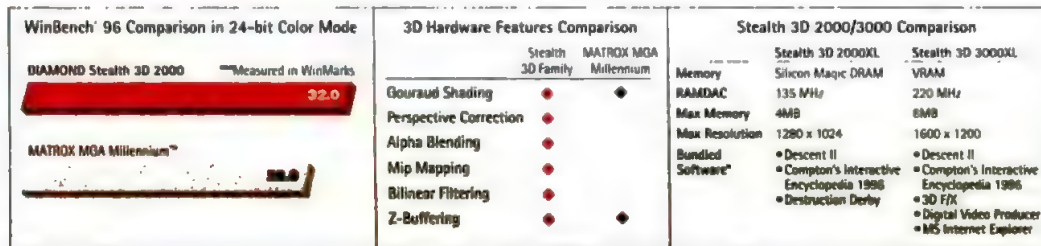
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A Hidden Treasure

This adventure game mixes stunning graphics with challenging puzzles.

Qin: Tomb of the Middle Kingdom

If you're a fan of those cool archaeological documentaries on the Discovery Channel, you'll like *Qin: Tomb of the Middle Kingdom*. Okay, if you liked even *one* of the Indiana Jones films, you'll like this game.

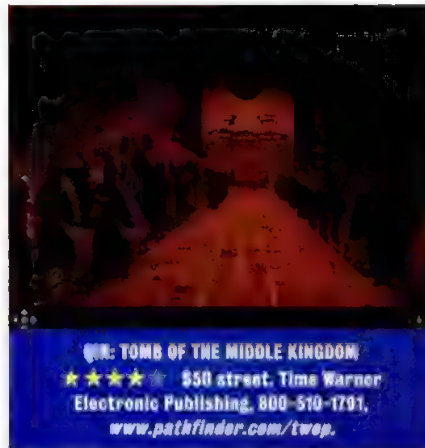
Unlike other archaeological quest games that are built around fictionalized lost civilizations and ancient artifacts, *Qin* (pronounced "Ching") is based on fascinating historical facts. The game runs on Windows 3.x and Windows 95.

One of history's great finds, the tomb of Qin Shi Huangdi, China's first emperor, remains largely unexplored to this day. Though *Qin* accomplished great things, such as uniting six rival states into one country and instituting a single currency that facilitated widespread trading, he had his bad points. For example, he had sealed—alive—within his own tomb the hundreds of thousands who spent 30 years building it.

The year is now 2010, and you've been selected to help explore the tomb. You must venture in, solve the many puzzles that reveal more of the temple, and get out alive.

Filled with over 1,300 SVGA screens, this MYSTifying world (sorry, we couldn't resist) is definitely pleasing to the eye. You walk from screen to screen, solving the several puzzles that stand between you and the rest of the tomb. Unlike the case in many adventure games, *MYST* included, the puzzles in *Qin* blend naturally into the game's world.

To make the puzzles even more difficult, you have to deal with them using ancient oriental script for clues. A little rusty on your Chinese? Lucky for you, you have a translator that can decipher the foreign words. There's also an encyclopedia of sorts that you can access throughout the game. This resource offers vital background information for each room you enter—for example, an expla-



nation of Chinese cosmology. Some gamers may wince at the idea of having to rely on extra resources to see them through,

but since *Qin*'s accomplishments put him on a par with such other leaders as Alexander the Great, the encyclopedia makes for fascinating reading. And though there are a few brain twisters, adventure game fans should be able to complete the game without too much trouble.

One thing is certain: Despite what the legend threatens, *Qin: Tomb of the Middle Kingdom* is anything but cursed.—Shane Mooney

Wham! A Homer!

EA's latest sports sim is a winner.

Triple Play 97

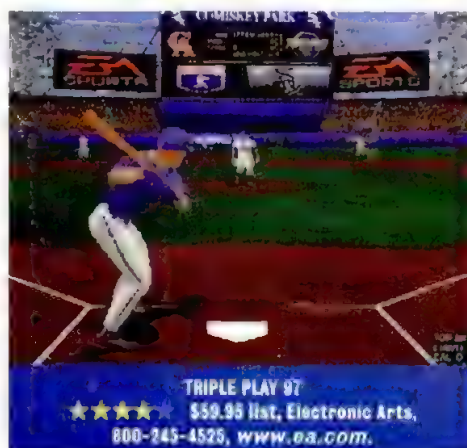
Yes, sports fans, the Boys of Summer have packed it in for the winter, but that doesn't mean you can't still get your daily baseball fix. Thanks to Electronic Arts' *Triple Play 97*, you can fire up some of the most entertaining baseball fun ever to grace a PC screen.

The game's tremendously appealing interface immediately draws you into the virtual baseball world. Even little things, such as the cool set-up graphics, the choice of background music, and the introductory video (which is spectacular), make jaded gamers like ourselves sit up and take notice.

You have access to all the major-league teams, complete with over 700 real players.

And every major-league ballpark is represented in *Triple Play 97*. Before each game in the Bronx, for example, you get treated to a flyby of a wonderfully rendered 3-D Yankee Stadium (Andy Pettitte's name is rather embarrassingly mispronounced in the game, though).

The game can be played in



five modes: exhibition, full season, all-star, playoff, and series. Each mode can be played at rookie, pro, and

manager levels. In manager mode, you can draft, create, and trade players just as in the big leagues.

So what is actual game play like? Even though it lacks the plethora of control options found in games like Sierra's *Front Page Sports: Baseball Pro '96 Season*, *Triple Play 97* is a lot more fun—and it's much, much easier to play. You get only a handful of pitches to choose from, but you can have complete control of your runners and fielders. The motion-captured graphics, though not stellar, are fluid and more than adequate, with players matching some of the physical characteristics of their real-life counterparts. Statistically, players also perform in a reasonably true-to-life fashion.

Statistics fans will probably prefer *Baseball Pro '96* or *Tony La Russa Baseball 3*. But compared with other action-oriented baseball sims like *Hardball 5*, *Triple Play 97* shines. It's easy enough for novices to grasp quickly and complex enough to keep more serious sports sim fans challenged and entertained.—SM

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Microsoft Excel 7.0 for Windows 95	79	86	86	80	82	78	79	74	78	79	78	73
Microsoft Excel 5.0 for Windows	78	88	83	77	79	75	78	68	79	78	75	73
Quattro Pro 5.0 for Windows* (formerly from Novell Inc.)	77	87	83	76	79	77	78	71	74	75	70	73
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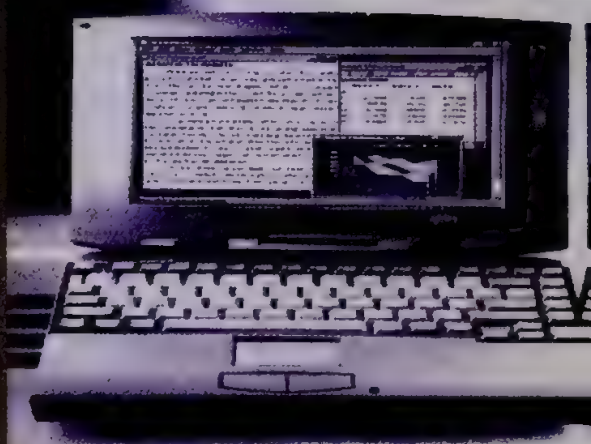
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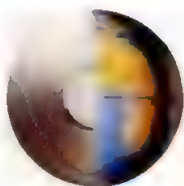
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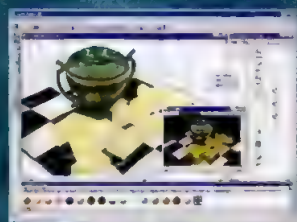
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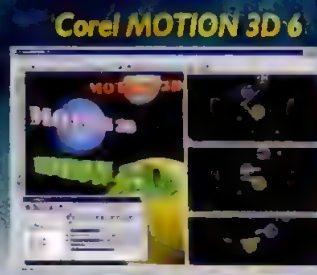
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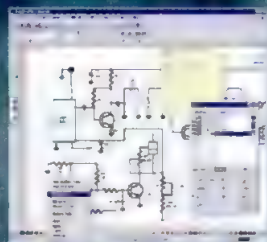
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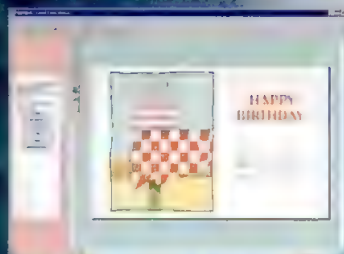
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For Additional Categories See MARKETPLACE PRODUCT INDEX, Page 426.



Coming Up

Software: Suites Sneak Peek

Each major player in the suites arena is revving up to release new upgrades. We take an in-depth look at the prerelease versions and examine each suite's application integration/common code, Internet tools, collaboration, and programmability. In sidebars, we discuss the latest features of the suites' components: word processors, spreadsheets, databases, and presentation graphics tools. We have also compiled a table that shows you what you get in these new suites compared with what you found in their older versions.

Internet Service Providers: The Net Grows Wider

The online universe is expanding at such a rapid clip that if you don't already have Internet access, chances are that a new service is popping up right now to deliver it to your front door. Now even telephone companies are getting in on the Internet access act, making the Internet the utility of the nineties. But which Internet service provider offers the best service, software, and rates? We review 17 providers, ranging from the traditional big-name online services—America Online, CompuServe, The Microsoft Network, Prodigy, and WOW! from CompuServe—to the major national "straight Internet" services: AT&T, Concentric Network, EarthLink, GNN, GTE, IBM, IDT, MCI, MindSpring, NetCom, SpryNet, and Whole Earth Networks.

Linking Your Network to the Net

Businesses that want to give their network users Internet access face a snarl of logistic questions. In addition to data security, cost, and bandwidth issues, there's the fact that many networks today speak IPX, the protocol used by NetWare, while the Internet is based on the TCP/IP protocol. PC Magazine Labs tests three turnkey gateways for connecting IPX-based networks to an Internet service provider. We also examine leading software-based IPX-to-IP gateways and give you information on choosing an Internet provider for your business.

Personal Investment Software

Is your financial portfolio in need of a tune-up? Do you need to get a better grip on your investments? Then be sure to check out our roundup of the seven major Windows applications that help you track your portfolio and keep it up to date via online links. We also take a quick look at the evolution of expert analysis tools for market tracking and offer a brief review of an online service dedicated to the world of finance.

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NE—Network Edition.

For information about the Network Edition of *PC Magazine*, call Circulation at 800-289-0429.

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Hope They Keep the Air-Conditioning Set on Low

"Office Assistant/Nude Models (female only) for X-rated Web site designer in Marina Del Rey area. No experience necessary. Will train. Some computer experience a plus. Must be able to handle busy office and do occasional nude modeling when needed. Fun job! Part or full time."

—THE LOS ANGELES READER

Can you  guess where on the Web we found this discouraging notice? Here's a clue: The initials are I.R.S.

The average response time is currently 1439968.3 business days

Sheesh! With Troubleshooters like These, Who Needs Enemies?

"Even if you have carefully followed the configurations procedures outlined in this guide, there is still no guarantee that your Solaris installation will proceed smoothly." —SOLARIS 2.5 CONFIGURATION GUIDE

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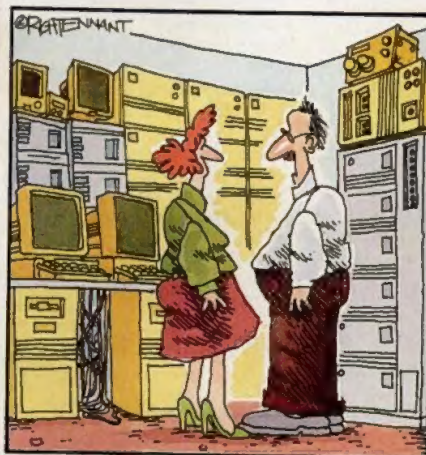
 "Hands-off" training? Computers are "time-wasters" and "roadblocks to retention," according to this National Seminars Group brochure.

Dramatic Contest for Sensitive Poet Types!

It's time for the first-ever ARF Haiku Competition! The poets who send in the three haikus that best express love and admiration for their PCs will each win \$50 and a highly coveted *PC Magazine* T-shirt. For those of you who may have forgotten, a haiku is a 17-syllable poem divided into lines of 5, 7, and 5 syllables. Send your entries to one of the addresses at the bottom of the page by November 18 to be eligible. Good luck!

All vendors bringing diskettes in to be used on Wal-Mart computers, must be scanned by the receptionist for VIRUSES!

 ...And then we'll delouse you. (Spotted at a Wal-Mart in Ontario, Canada.)



RICHARD TENNANT

"We're researching molecular/digital technology that moves massive amounts of information across binary pathways that interact with free-agent programs capable of making decisions and performing logical tasks. We see applications in really high-end doorbells."

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to don_willmott@zd.com. Winners this issue: Pablo Dominguez, Dennis Hatton, Sean Huang, Tim Mallory, and Sifu Wang.

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